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OBSERVATIONS

ON

VENTILATION.

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OBSERVATIONS

ON

VENTILATION,

AND ON THE

DEPENDANCE OF HEALTH

ON THE

PURITY OF THE AIR WHICH WE RESPIRE;

BEING THE SUBSTANCE OF

LECTURES,

DELIVERED ON THIS SUBJECT,

AT THE REQUEST OF

THE DUBLIN SOCIETY,

IN THEIR

THEATRE, IN 1818.

BY ANTHONY MEYLER, M. D.

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The following pages are most respectfully inscribed by the author, to the Right Honorable

THE LORD ROBERT SEYMOUR,

in grateful testimony of his Lordship's condescension and kindness.

A work written with the view of improving the internal œconomy of our public institutions, may with peculiar propriety, be dedicated to a Nobleman, distinguished even in this age of enlightened benevolence, for exertions as zealous as they are valuable in the cause of science and humanity. Whilst the many, merely declaim on the defects of our philanthropic establishments, or limit their assistance to pecuniary aid, it is his Lordship's province to enter into the minute and varied details of practical benevolence; and to enhance the benefits derived alike from his influence and liberality by what is still more meritorious and valuable—an unwearied and judicious superintendance.

LONDON,—February 5, 1822.

Several errata have occurred in the printing, but as they do not affect the meaning, it has not been deemed necessary to specify them.

Introductory Observations.

THE object of the following pages is to illustrate in a popular form, the dependance of health on the purity of the air which we respire, in order that the public attention may be directed to the necessity of establishing a more efficient and systematic mode of ventilation, than has been hitherto attained. There is, perhaps, no physician, who in the course of his professional pursuits, has not been frequently led to witness the many ill effects resulting from the influence of impure air, and to observe, that in consequence of a defective system of ventilation, or from a total disregard of this object, the atmospheres of our public institutions, as well as of our private dwellings, have been surcharged with animal exhalations and other offensive effluvia, so as to impair considerably the salubrity of these respective places, and frequently, even to produce in them diseases, which subsequently acquired a very extensive and malignant diffusion. In the present improved state of society, when

humanity is studied as a science, and the benevolent impulses of our nature are placed under the direction of that knowledge, which alone can adequately regulate such feelings, and direct them in a profitable course; it would scarcely be credited by those unacquainted with the subject, that any *removeable* cause of human suffering, would be allowed to prevail, still less, would it be supposed, that institutions erected for the purposes of benevolence, should, from the imperfection of their construction and of their internal regulations, be the means of producing those evils which they were established to prevent. Strange, however as it may appear, it is nevertheless true, that in our prisons, our hospitals, our factories and our schools, the germs of disease are nurtured and matured; and that from these impure sources, they take a wider range, and produce a more extensive scene of mortality.

We find, that the best concerted military enterprises have, in many instances, been rendered abortive, and the lives of our seamen and soldiers uselessly wasted, in consequence of congregating crowds together, without adopting the necessary precautions to supply them with pure air. Our ships and military hospitals have been infested with a loathsome and fatal gangrene, and the diseases generated in our crouded encampments have desolated the ranks of the army, aggravating the mortality of war, by the still more destructive influence of the *war fever and pestilence.*

The reader, who for the first time, has convinced himself of the truth of the above statements, will, perhaps, be disposed to attribute our remissness to a cold indifference for the lives and sufferings of our fellow creatures. But, on pursuing the investigation, he will find, the same causes of disease suffered to exist in the splendid residences of the

the luxurious and opulent. He will find our churches, our theatres, our places of business and of amusement, our courts of law, our houses of parliament, the palace of the monarch, as well as the residence of the artizan infected by pestilential air. On tracing the influence of this noxious agent in these respective places, he will find, that though it is not so alarmingly manifested as in the instances already specified, it still exerts a decidedly injurious impression, it lowers the general standard of health, it renders us more susceptible of of disease, and aggravates diseases already existing, and still farther shortens and embitters the narrow span of human life. When, therefore, he finds that impure air is the most fertile source of many maladies, improperly attributed to other causes, and that the means of removing this evil have not been resorted to, even in private dwellings, he will cease to declaim against the inhumanity of the age; but the indifference thus manifested with respect to health, will afford a new and fertile subject for surprise and reprehension.—He will see how slowly useful improvements advance into general adoption, how much man is the creature of habit, and how custom blunts our perception of an evil, and causes us to bear its inflictions without seeking to remove it, disposing us rather to regard it as one of those unavoidable visitations of providence, which man may deplore, but cannot prevent.

It is much to be regretted, that the knowledge of the laws of the animal œconomy, and of the causes that contribute to the preservation of health do not form a more favorite branch of general study, were this informarion more generally diffused, our legislators in providing for this most important object, would be guided by a more enlightened spirit; and our public establishments

would then become more useful, by being subjected to the direction of a more scientific observation. The people as large require no precautions to guard them against the dangers which they see; but it becomes absolutely necessary to warn them against those causes of disease which operate unseen, and which, therefore, are not manifested to the watchful instinct of self preservation. When pestilence desolates a country, we are painfully affected with a view of its ravages. and inquire what means have been employed to arrest its progress, and to terminate its malignity; but we pass over, unregarded, those causes of disease to which numbers silently fall victims, and which in secrecy and obscurity mature their deadly means of destruction—till some general malady becomes the too fatal proof of their influence and existence.

Although it must be admitted that our habits of cleanliness and other measures of security, have contributed to diminish many diseases, by which our ancestors were assailed; the causes of which were also, in former times, but imperfectly understood, and against the recurrence of which no adequate means of prevention were employed; yet, if we reflect on the constant generation of disease in the confined and filthy dwellings of the poor in our own time; if we contemplate the state of our fleets and armies, our hospitals and prisons, we must be compelled to admit, that many removeable causes of disease are yet permitted to exist; and, though all writers on those subjects have been unanimous in proclaiming the existence of the evil; yet no general or effective measures have been adopted to remove it. It is not sufficiently known how many fall victims to this fatal negligence and that the number far exceeds even the estimate

timate of those who have directed their attention to inquiries of this nature. The science of *preventative* medicine has, as yet, made but a slow and insufficient advancement.

In order that the public, by being made acquainted with the existence and cause of the evil, may be induced to adopt the means of removing it, I have been led to place before them the following facts and observations, illustrative of the injurious consequences of habitually respiring an impure atmosphere. If the most respectable medical authorities declare, that the health of our different institutions suffers from their defective ventilation. If diseases, proceeding from this cause, do *now* actually exist in the prisons and hospitals of these countries; the respective governors of these places will, surely, not limit their sympathy to merely deploring the evil, but will use their influence and exertions altogether to remove it; and if the means recommended should, by some, be considered expensive, let it be remembered, that the object is THE PRESERVATION OF HUMAN LIFE.

Connection of air with life.

Among the many agents that contribute to the support of life, there is none more important than the air which we breathe; nor is there any thing more conducive to health than the purity of the atmosphere in which we live.—RESPIRATION is one of the functions most essential to life—it is a function also which is in full and unintermitting action during every moment of our existence, on the respiration of a pure atmosphere, in a great measure depend the nutrition, the growth, and the health of all animated beings. Surrounded by confined air, plants droop

droop and die, while man, from the same cause, becomes debilitated in frame, and obnoxious to disease.—Even our own sensations inform us of the influence of this agent, its relative weight or levity, its varyiug temperature, its greater or less moisture, the direction from which it blows, the nature of the soil over which it passes, all produce on us a corresponding impression, and manifest the paramount influence of this fluid in the preservation of health and life. The distint nature of the connection of air with life, and the importance of breathing this fluid in a state of purity, will be more evident, by considering the composition of the atmosphere, and its influence on respiration and other animal functions.

Theory of the constitution of ærial bodies.

All the accurate knowledge we possess of the phenomena and uses of respiration, has resulted from the recent discoveries of the different species of elastic fluids: perhaps therefore, this functiou will be better understood, by, in the first instance, affording a general review of the constitution of this class of bodies; the discovery of whose nature and distinct existence, has, in so eminent a degree, facilitated the progress of the arts, and extended the boundaries of philosophy. All the materials of nature present themselves to us, either in the solid fluid or æriform state.—It was at no very distant period imagined, that these several forms of matter were essential, or in other words, that some bodies were *naturally* fluid, while others were æriform, or solid. The progress of discovery has placed this subject under a more correct point of view, and has reflect-

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ed a truer light on those causes, which produce and vary the relative consistence of bodies. Every substance in nature would be solid, but for the influence of heat: It is this agent which renders a solid fluid and converts a fluid into air. Water affords a familiar illustration of this doctrine, it is either solid fluid or æriform, as we increase or diminish its temperature. The variety, which exists in the consistence of bodies, proceeds from their varying tendencies to assume these several states at different temperatures. Some substances become fluid or æriform, only in consequence of a very intense degree of heat, while others assume these forms at so low a temperature, that we cannot render them solid or fluid, by the greatest degree of cold we are enabled to produce It requires 3000° of Farht. to render iron fluid, while mercury, another metallic substance, continues fluid at the coldest temperature of our climate.—— Yet mercury may be converted into a solid or ærial substance by diminishing or increasing its temperature. Were we enabled to produce a sufficient elevation of temperature, every substance in nature might be converted into air; on the other hand, by an adequate reduction of heat, every fluid and æriform body might be rendered solid. It being admitted that gases, are solid material substances, rendered ærial in consequence of their combination wiih caloric, and that various substances are capable of assuming this form at the usual temperature of the atmosphere, it necessarily follows, that gases must exhibit great variety in their combination and mode of action.— Some of them will support combustion as oxigen chlorine, others are themselves combustible, but will not support combustion as hydrogen gas.—— Some are acid, others are alcaline. Some airs are incapable of sustaining life, others wiil support

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it with more vividness, and for a longer period than the same quantity of atmospheric air. Some airs destroy colours, others vary them, or render them more brilliant, &c. &c. &c.

Air is, therefore, now no longer considered as a simple elementary substance, recent experiments having demonstrated, that there are several distinct ærial bodies, whose nature and composition are essentially different, and that these gaseous substances manifest the same distinctness and variety in their modes of action, that distinguish the combinations of other forms of matter, and that however concealed in the tenuity and transparency of their nature, they nevertheless exert a sensible and material influence in their union with other bodies, and impress on them new and peculiar properties. The discovery of their distinct existence and mode of action, has reflected a truer light on every department of nature. The grosser forms of matter have been connected by a new link with the æthereal elements of electricity, heat and light, and another mode of existence has been revealed in the endlessly diversified gradations of nature.

Atmosphere.

The discovery of these different fluids has afforded us more accurate views of the composition and uses of our atmosphere, and has pointed out its extensive agency in the operations of nature, and more particularly in its connection with animal life.

The mass of air, which surrounds our globe to a considerable height, seems to be a compound of pure air blended with a variety of exhalations from animals, vegetables and minerals, and must therefore be more or less pure in proportion to the nature

nature and quantity of the exhalations with which it is charged. Nature, however, by some concealed, but admirable contrivance, has made ample provision for withdrawing these extraneous substances from the general atmosphere, and the the chemist, in his experiments to ascertain the composition of this elastic fluid, finds, that it consists permanently of two kinds of air, whose properties are essentially different. One of these æri form bodies is called *oxygen gas* or *vital air*, the other is called *nitrogen gas*. Oxygen gas is that portion of the atmosphere which alone supports combustion and animal life; nitrogen gas is alike fatal to both, In calculating the relative proportion in which these two gases enter into the constitution of the atmosphere, if we estimate by volume it will be found, that 100 parts of the atmospheric contain about 20 parts of vital air, and 80 of azotic gas. It therefore contains only one-fifth of that particular air, which alone supports combustion and animal life.

Previously to the discovery of the constitution and uses of the atmosphere, we had no accurate knowledge of the phenomena, and uses of respiration. The great importance of this function, and the absolute necessity of air to life, were too obvious not to be observed, even in the earliest dawn of medical science. But the distinct nature of this connection, and the true knowledge of the phenomena which result from it, have only been accurately understood since the period that Dr. Priestly commenced his observations on the composition of the atmosphere, and on the influence of this invisible, but material agent, in sustaining the complicated mechanism of organised life. Since that time, a multitude of experiments have been performed, to discover the phenomena of respiration. The

blood drawn from the body has been subjected to the action of different ærial fluids. The atmosphere has been examined previously to and after respiration. Animals have been shut up in glass vessels filled with different gases; man, also, by the aid of ingenious machinery, has subjected himself to the influence of a diversity of ærial bodies; and the result of these multiplied and judicious experiments has been an accumulation of valuable facts, which has reflected a true and hitherto unknown light on this most useful and important function.

Changes produced in the atmosphere by Respiration.

Respiration may be considered under two points of view; first, as it regards the changes produced in the air which is respired; and secondly, the influence which this respired air exerts on the blood, and through its means, on the animal frame. It has been long known, that a certain quantity of air will sustain life only for a limited period. More recent inquiries have added to these facts the knowledge of the particular air that will alone sustain life, and the exact nature of the changes produced in the atmosphere by respiration. It has been ascertained, by innumerable experiments, that respiration destroys the oxygenous portion of the atmosphere, and that the air, which has thereby served for the respiration of one animal, is fatal to another animal introduced into it. In like manner, the atmosphere is deprived of its oxygen by combustion, and becomes thereby incapable of sustaining the combustion of any other burning body. From whence it appears, that the part of the atmosphere which supports combustion, is that also which is alone capable

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of supporting life, and respiration and combustion, alike produce such changes in this fluid, as render it unable to sustain these operations without a constant supply of fresh air. As pure oxygen gas supports combustion for a longer period, and with more vividness than atmosperic air, so also will a limited portion of oxygen gas sustain life with more energy, and for a longer period, than the same quantity of atmospheric air. A small animal, confined in oxygen gas, lives three times as long as when confined in the same bulk of the atmosphere; and those individuals who have breathed an atmosphere artificially charged with an increased portion of oxygen, have declared, that the heat of the body has increased, the colour of the face has been heightened, and that the animal functions have been performed with increased energy. It has also been experimentally ascertained, that by the respiration of oxygen, a greater portion of carbon is withdrawn from the blood, than by the respiration of the same quantity of atmospheric air.

When the influence of different gases on respiration was first ascertained, Drs. Beddoes, Thornton and others, anticipated considerable advantages from their use in medicine, and various pneumatic institutions were established with this view. Experience has, unfortunately, not realized these flattering hopes; but there certainly are some well authenticated facts that would lead us to suppose, that benefit would result, in some instances, from breathing an atmosphere artificially surcharged with oxygen.—In the recovery of suffocated persons, this gas from its superior stimulating power, might doubtless be beneficially employed.

It has now been fully ascertained, by the experiments of Lavoisier, Humboldt and others, that no animal can live in air, totally destitute of oxygen. Even fish, which do not sensibly respire, die very soon, if the water in which they live be deprived of it. Frogs, which can suspend their respiration at pleasure, die in about forty minutes, if the water in which they are confined be covered with oil. Insects and worms, as Vauquelin has proved, exhibit precisely the same phenomena ; they require air as well as other animals, and die like them if they are deprived of it ; they diminish the quantity of oxygen in the air in which they live, and give out by respiration, the very same products as other animals. Worms, which are more retentive of life than most other animals, or at least not so much affected by poisonous gases, absorb every particle of the oxygen contained in the air, in which they are confined, before they die.*

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* Numberless animals have been destroyed to prove the incapacity of a limited quantity of air to support life beyond a certain period ;—the following instances evince that man cannot be shut up in confined air with impunity :—

" Fort William, at CALCUTTA, had been surrendered to the *Suba*, of Bengal, in the afternoon of the 20th of June, 1765, and between seven and eight o'clock of the same evening, Mr. Holwell, who had then become chief in council, with the other civil and military officers of the India Company, their servants and soldiers, amounting in all to 146 persons, were forcibly driven into a prison, called the BLACK HOLE, which was a *cube of about eighteen feet*, ' shut up by dead walls on the east and south, (the only quarters from which the wind could reach them,) by a wall and door to the north, and open only to the west, by two windows, *strongly barred*, from which they could scarcely receive *any the least* circulation of air.' In this state, these unfortunate persons, previously exhausted by fatiguing exertions to defend the fort, and with only

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It having been proved that the oxygenous, or vital portion of the atmosphere is destroyed by respiration, various experiments have been instituted, to ascertain the exact quantity of the oxygen which is vitiated, or which appears to be withdrawn from the atmosphere by this function. The

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standing room, (i. e. 26½ inches by 12 inches to each person, upon the average,) in a very sultry night, soon fell into an excessive pespiration, which was followed by extreme thirst; and this became the more insupportable as their bodies were more and more deprived of moisture. To gain more room, they stript off all their clothes; and to relieve the fatigue of standing upright, they all sat down on their hams, or rose up at given signals; but they were so wedged up while sitting down, that it required considerable efforts to rise, and several, who were too weak to make such efforts, were either throdden to death, or suffocated. 'Urinous effluvia soon pervaded the interior of the prison, which, at last, became very powerful, and to use Mr. Holwell's words, 'affected them as if they were forcibly held with their heads over a bowlful of strong volatile spirit of hartshorn until suffocating.'— In the meantime also, the atmosphere was gradually more vitiated, so that 'before nine o'clock, every man's thirst grew intolerable, and respiration difficult.' In this distressing situation, the prisoners cried loudly for water, and when water was at length brought by some of the guards, with such eagerness did they struggle to get it, that not only the greatest part of the water, handed in hats through the bars of the prison, was spilt before it reached any one's lips, but many were trampled down and suffocated, while others, particularly those who stood near the windows, were pressed to death. It was soon, however, discovered, tbat draughts of water were of little service towards quenchiug a thirst produced and kept up by such causes; they, therefore became clamarous for AIR, and endeavoured to force the door of the prison: but finding their attempts vain, and preferring an immediate death to the lingering extinction which they apprehended as their doom, they grew outrageous, and abused the *Suba*, and his officers, and their own guards, by the most opprobious names, 'to provoke the latter to fire in upon them; every man that could, rushed tumultuously towards the window, with eager hopes of meeting the first shot; then a general prayer to heaven, to hasten the approach of the flames

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The results of these experiments have varied so considerably, as to leave no doubt but that the quantity of oxygen consumed by respiration, varies not only in different individuals, but also in the same person at different periods. The amount of the consumption of oxygen by respiration, appears to be influenced by the period of life, the passions of the mind, the state of health, the quantity and nature of our food, and other causes. From a general average of the most accurate of these experiments, we may estimate, that the quantity of oxygen which disappears by respiration,

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to the right and left of us, and put a period to our misery.' After such violent exertions, they, whose strength and spirits were quite exhausted, laid themselves down, and expired upon some of their companions; others, who had yet some strength left, made a last effort for the windows, and several succeeded by leaping aud scrambling over the backs and heads of those in the first ranks, and got hold of the bars, from which there was no removing thom afterwards. In this manner, which is more easily conceived than described, was the remainder of the night passed; and when at dawn of day, an order was brought for their release, only twenty-three persons remained alive out of 146, and those were so weak, that it took more than twenty minutes to remove the dead piled against the door, so as to procure a passage out for one at a time."—*Holwell's Narrative.*

The annals of the slave trade, more particularly in the avaricious cruelty in which this most abominable traffic in human blood was pursued, abound with instances of suffocation from confined air. In the evidence before a select committee of the House of Commons, it appeared, that in four ships, belonging to the same concern, out of 2064 slaves, they lost 586; and ships in this horrid species of mercantile speculation, frequently, *from want of pure air*, lost from a third to a half of their cargo of human beings. Dr. Trotter, who went out as surgeon, in some of these ships, states in his evidence before the committee, that the slaves were confined under deck, in rooms only five or six feet high, and ventilated only by a grating above, and this even was frequently covered,

tion, amounts in the minute to 31·6 inches of oxygen, which, in twenty-four hours, will be 45,504 cubic inches,* that is about 25 cubic feet, or 197 gallons of vital air, are daily destroyed by respiration of each individual.—Now, since the oxygen amounts to only about one-fifth of the atmosphere, it follows, that in a day, a man destroys or renders totally unfit for respiration or combustion, 125 cubic feet of the atmosphere, that is nearly one gallon of air per minute. But if we consider that the atmosphere becomes deteriorated long before all its vital portion is destroyed, and as each respiration contributes to impair its purity, we may estimate the quantity of oxygen, vitiated by this function, as considerably above that amount. Under this view we may calculate that each individual requires, for healthful respiration, three gallons of fresh air per minute.—The alteration produced in the air by respiration, does not consist merely

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covered He says, that he himself could not breathe in the place where these wretched beings were confined, except when directly under the gratings. He describes the sufferings of these poor people as dreadful, from want of air,— "I have often observed them," says he, "drawing their breath with all the laborious and anxious effort observed in animals subjected by experiment to breathe a foul air, or placed in the exhausted receiver of an air-pump, crying out in their own language, *that they were suffocated*, some, as the capricious humanity of their keepers might dictate, were occasionally rescued from a dying state by being brought upon deck, "*and many*," says Dr. Trotter, "*have I found dead in the morning* FOR WANT OF AIR, *who, the night before, shewed no signs of indisposition.*"

A variety of similar incidents of death occurring from air, deprived of its vital principle by respiration, might be quoted if it were necessary to multiply them.

* Sir H. Davy's estimate, which I have adopted, nearly agrees with that of Lavoisier.—*See Davy's Researches, p.* 433.

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in withdrawing its oxygen ; the place of this vital portion of the atmosphere is supplied by an equal volume of *carbonic acid gas*, another species of elastic fluid, which is not alone incapable of sustaining life, but which is even positively fatal to it.*

Thus it appears that respiration not only decomposes the atmosphere, but that it substitutes for that vital portion of it which it destroys, an extremely poisonous gas.

Circulation of the blood, nutrition, digestion, &c.

The necessity, however, of renewing the air of our apartments, and the ill consequences resulting from the respiration of a vitiated atmosphere will be still more strongly evinced by investigating the nature of those changes, which respiration produces on the blood, and through its means on the animal frame. To illustrate this part of the of the subject, it will be necessary in the first instance, to take a general review of the circulation of the blood.—There is not in any department of nature, a phenomenon more wonderful, nor is

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* This gas is most commonly known by the appellation of fixed air—it is distinguished by being peculiarly fatal to animal life ; it also extinguishes burning bodies ; it is so heavy, that it may be poured out of one vessel into another. This ærial body is produced in great abundance by combustion, fermentation, and other chemical operations ; it is also emitted in many places from the earth—it abounds in mines, where, from its deleterious properties, it is called the *choak damp*. The respiration of this gas is the cause of those fatal accidents which happen to people imprudently venturing into vaults aud cellars recently opened, and which have not been ventilated.

there

there any function in the animal æconomy more beautiful, or more worthy of observation, than the circulation of the blood. Like the function of respiration, it goes on incessantly, even while all the senses are suspended, and by its never ceasing agency, all the parts of the body are supplied with the materials of their growth and renovation, while warmth, life and animation are conveyed to every part of our frame.—The blood is a fluid, which circulates through every part of our system, by means of two sets of vessels, which according to their respective services are called *arteries* and *veins*. The *heart* is the centre and great moving power of the circulation. The external appearance of this organ is familiar to every one, and it is nearly the same in all warm blooded animals.—The arteries and veins are hollow cylindrical tubes: the former carry the blood *from* the heart to all parts of the body, the latter collect and return the blood *to* the heart. Thus, the heart, the arteries and the veins, are the organs by which the beautiful system of the circulation of the blood is carried on. A large artery called the *Aorta*, rises from the left cavity of the heart, and subsequently divides itself into innumerable branches, and there is not a single part of the animal body, to which a due supply of blood is not conveyed by these ramifications. The blood thus distributed from the heart by the arteries, is brought back again to the heart by the veins.

The arteries increase in number and decrease in size in their progress from the heart, till ultimately divided into extremely minute and innumerable ramifications, they terminate in, and pour their contents into the veins. The veins collect the blood by their minute ramifications, and decreasing in number, and increasing in size, in their progress towards the heart: they ultimately

unite into two great trunks, called the *Venæ cavæ*, and pour their contents into the heart; to which the blood returns as to its source, whence it is again circulated and diffused. The blood is the great vital stream which supplies the materials for the growth and nutrition of the animal body; the fluid as well as the solid parts, the bones as well as the muscles derive from it the materials of their growth and renovation. The stomach is continually recruiting the mass of the blood, and furnishing it with fresh supplies, to enable it to continue its important functions. The nutritive portion of the food which we consume, is by the operation of the stomach and other organs, converted into a milk like fluid, called *chyle*. This chyle is poured into the blood, to which it becomes assimilated, and then forms a part of the general circulation. Thus the nutriment which we derive from our food, is ultimately converted into blood, whilst this vital and sanguine stream, running its uninterrupted course through the body, is incessantly repairing the waste, supplying the accession of new substance, and distributing to every part of the frame, the nourishment which it requires. *

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* The circulation of the blood and its connection with the stomach, is not unhappily described by the Poet in the following words:

" The blood the fountain whence the spirits flow;
The gen'rous stream that waters every part
And motion, vigour and warm life conveys
To every particle that moves and lives,
This vital fluid, thro' unnumber'd tubes,
Poured by the heart and to the heart again
Refunded; scourged for ever round and round;
Enraged with heat and toil, at last forgets
Its balmy nature; virulent and thin

It

Circulation through the lungs.

This view affords a general idea of the circulation of the blood, so far as it is connected with our growth and nutrition; but when considered with reference to respiration, it will be necessary to take a more particular review of this function: The heart is the centre, not only of *one* but of *two* distinct circulations. Without entering into a minute anatomical view of the internal structure of this organ, it will be sufficient to state generally, that it is divided by means of a strong muscular partition into two cavities, which from their respective situations are called the *right* and *left* cavities of the heart. Each cavity is supplyed with veins, that carry the blood *to* it, and with an artery, that carries the blood *from* it. Each side

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It grows, and now but that a thousand gates
Are open to its flight, it would destroy
The part it cherished and repaired before.
Besides the flexible and tender tubes
Melt in the mildest most nectarious tide
That rip'ning nature rolls, as in the stream
Its crumbling banks; But what the vital force
Of plastic fluids hourly batters down
That very force those plastic particles
Rebuild; so mutable the state of man
For this the watchful appetite was giv'n
Daily with fresh materials to repair
This unavoidable expense of life
This necessary waste of flesh and blood.
Hence the concoctive powers with various art
Subdue the cruder aliments to chyle
The chyle to blood, the foamy purple tide
To liquors which thro' finer arteries
To different parts their winding course pursue,
To try new changes and new forms put on.

ARMSTRONG, on health

of the heart is thereby the centre of a particular and distinct circulation. The Aorta, as we have already seen, rises from the *left* cavity of the heart, and by means of its numerous ramifications distributes the blood throughout the body. This fluid is brought back again to the heart by the veins, but not to the left cavity, from which it set out, but to the right cavity. A large artery called the *pulmonary* artery, arises from the *right* cavity of the heart; this artery is distributed solely thro' the lungs, and the blood having been thereby exposed to the influence of the air which we are incessantly respiring, it is conveyed by the pulmonary veins to the *left* cavity of the heart, to be again circulated through the general system.—The importance of respiration is thus rendered evident, by this admirable mechanism; by which the blood, having run one course through the body to administer to the different purposes of life, is then circulated through the lungs, to be fitted to perform a second circulation.

Structure and œconomy of the lungs.

We may estimate the necessity and the great extent of the action which the inspired air exerts on the blood, from the very ample provision nature has made for its operation.—The lungs of a full grown man contain on an average, about 280 cubic inches, or nearly 5 quarts of air. The seventh of this quantity, that is 40 cubic inches of air, is inhaled at each inspiration, and the same quantity is also expired. If, therefore, we calculate, that 20 inspirations take place in the minute, and 40 cubic inches the amount of each inspiration: it will follow, that in the minute we respire 800 cubic inches, in an hour the quantity of

of respired air will be 48,000 cubic iuches, and in the 24 hours, it will amount to 1,152,000 cubic inches. Thus we respire every day a quantity of air, that would weigh nearly 53 lb. avoirdˢ. and if estimated by volume, would nearly fill 78 wine hogsheads.

The structure of the lungs is admirably well calculated to facilitate the chemical action, that takes place between the blood which circulates through them and this immense quantity of air which we are incessantly respiring. The lungs are of a soft texture, not unsimilar to a sponge. They consist of innumerable little vescicles, impending from, and communicating with the wind pipe. These vescicles, into which the air alternately passes and repasses at each respiration, are separated from the blood vessels only by an extremely thin transparent membrane, which Haller estimates only about $\frac{1}{1000}$ part of an inch in thickness. The internal surface of the lungs has been calculated to measure 15 square feet, that is equal to the amount of the whole external surface of the body, and on this extensive and delicate membrane, the branches of the pulmonary artery and veins are spread out as fine as hairs. By this structure, all the blood in the system is successively brought, almost in contact, with the air in the cells of the lungs, and it has been proved by experiment, that the extremely thin membrane which alone is interposed between the blood and the respired air, does not prevent their mutual chemical action. As the entire current of the blood is made to pass 552 * times in the course of the day in review,

* It is hardly possible to determine accurately the velocity of the blood's motion, varying as it must necessarily do from a variety of causes. If we calculate the quantity of blood contained

view, as it were, of the air through all the branches of the pulmonary artery, and back again through all the ramifications of the corresponding veins, it seems obvious, by their being so frequently brought nearly in contact through so extensive a surface, that they are destined to exert some important influence on each other. We shall now proceed to inquire what are the purposes answered by this admirable mechanism, and by this double circulation.

Changes produced in the blood by respiration.

The blood, in conveying the necessary supplies to the different parts of the body, and in the performance of the various purposes for which it serves, has its constitution and appearance considerably altered, it has undergone a variety of chemical changes, and is brought back again to the heart, in many respects, differing from the pure arterial blood that flowed from it. It is then circulated through the lungs to be fitted to perform a second circulation.—The most obvious effect produced by respiration on the blood is change of colour. The blood flows from the left cavity of the heart, of a beautiful red colour, it is returned by the veins, to the right cavity of the heart, of a dark purple colour. It is then circulated through the lungs, where it is changed into

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ed in the body at 30 lb. and the amount expelled from the left ventricle of the heart at each pulsation, at 2½ oz. and the number of pulsations in a minute at 75: The entire of the blood will pass through the heart about 23 times in the hour, performing the entire circulation in less than 3 minutes. The entire mass of the blood therefore passes through the lungs 552 times in the course of the day.

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a vermillion or red colour, and in this state it is brought by the pulmonary veins to the left cavity of the heart, to be again circulated through the general system.

It may not be uninteresting to the general reader, to state some of the means by which these facts have been ascertained. Blood when drawn from a vein, is uniformly found of a dark purple colour. When drawn from an artery, it is of a florid red colour. When the dark coloured blood drawn from a vein, is exposed to oxygen gas or atmospheric air, it becomes of a florid red colour, and Dr. Priestly has ascertained, that this change takes place, even though the blood be confined in a thin membrane. The atmosphere undergoes the same changes from the action of the blood out of the body, as it does from the function of respiration. Its oxygen disappears, and its place is supplied by an equal volume of carbonic acid gas. When dark venous blood is exposed to nitrogen gas, no change of colour ensues. When it is exposed to oxygen gas it is rendered of a higher colour, and this change takes place more rapidly than when exposed to atmospheric air.

The changes produced by respiration on the blood, have been still farther confirmed by opening the chest of a living dog, by which operation, the whole function of respiration, and the action of the heart and lungs was exposed to view.—The blood, conveyed into and propelled from the right cavity of the heart, was uniformly observed of a dark purple colour: but when it was circulated through the lungs of the animal, it was changed into a florid red colour, and was returned in that state to the left cavity of the heart. When respiration was artificially suspended, and the access of air into the lungs mechanically prevented

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the blood, in its passage through the lungs, instead of becoming florid, became more dark, deepening in colour as the air continued to be excluded. The pulsation of the heart and arteries also became more feeble, and the extremities more cold. The same appearances ensued when the animal was made to breathe an air that did not contain oxygen, and the same coldness and debility also followed. The dark coloured blood wanting those chemical changes produced in it by vital air, became unfit for the purposes of life, and incapable of stimulating the heart to action.—— When the respiration of the animal became more languid and imperfect from mere debility and exhaustion, the blood also continued dark as when this function was mechanically prevented. Under these circumstances, respiration was artificially sustained by means of a double bellows, which alternately inflated and emptied the lungs: the blood then regained its red colour, and the pulsation of the heart and arteries was excited anew.

The influence of respiration produces other and more important effects on the blood than merely change of colour, it has been sufficiently demonstrated, that respiration destroys the oxygen of the atmosphere, and supplies its place by an equal volume of carbonic acid gas, and as this air consists of oxygen combined with carbon or charcoal: one, of the great purposes answered by respiration, would seem to consist in withdrawing the superfluous carbon from the blood. *

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* It has been satisfactorily demonstrated that carbonic acid gas, is formed by oxygen and carbon: By burning charcoal in pure oxygen, we form carbonic acid gas, and on the other hand, we may decompose this gas by superior affinity, when the charcoal will be deposited.

It is not easy to determine the absolute quantity of carbon discharged from the blood by respiration, the amount varies, not only in different individuals, but in the same person at different times. The experiments, also, which have been performed to ascertain the amount, have given such various results, as to excite some doubt of their accuracy. Dr. Thompson is disposed to estimate the volume of carbonic acid gas discharged from the lungs in 24 hours, at 40,000 cubic inches. This quantity of carbonic acid contains nearly 3 quarters of a pound avoirdupois of carbon. Messrs. Allen and Pepys, found in their very elaborate experiments, about 27 ½ cubic inches of carbonic acid per minute, or 39.534 cubic inches in 24 hours, a quantity which contains about 11 oz. troy of solid carbon.*

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* 1000,000,000 human beings inhabit the earth—a man consumes two pounds of oxygen daily—all other animals consume twice as much.—By combustion, fermentation, &c. a quantity of oxygen is consumed equal to that by man. Weight of the atotmosphere 3986 cubic leagues of mercury—consumption of oxygen in 100 years, 1,459,285,922 cubic toises of mercury, or less than ⅓ of a cubic league; therefore, the diminution of oxygen in the atmosphere, supposing no renovating causes is less than $\frac{1}{7\,2\,5\,5}$ part in 100 years.—(Toise about 6 feet.)

Provost—Bibliotheque de Science, et des Arts, Geneva, July, 1816.

"No one that I know of has undertaken to calculate the quantity of carbonic acid, which is probably thrown into the atmosphere in any given time, in order to compare it with the whole quantity of the atmosphere. Now, if we state the diameter of the earth to be 8000 miles, and the circumference 25,000, in round numbers, the area of the earth will be 200 millions of square miles, calculating the weight of the atmosphere, at the rate of 15lbs. upon a square inch; for such a nuuber of miles we obtain 12 trillions of lbs averdupois; calculating also the quantity of carbonic acid, which 1000 millions of men (the supposed population of the earth) would expire

In tracing the influence of respired air on the blood, it is extremely difficult to ascertain the changes produced in this very complex fluid; nor is it the object of the present essay to enter into any discussions on this very difficult investigation. It, however, appears that the milky-like fluid called *Chyle*, which, as we have already seen, is elaborated from our food by the function of digestion, is poured into the blood, and it is then almost immediately conveyed to the right cavity of the heart, from whence it is circulated along with the blood, through the lungs, where, by the influence of respiration, its individuality is destroyed, and it becomes of the same nature as this circulating fluid. Respiration, therefore, is the agent by which part of the food which we consume is ultimately assimilated to the general mass of the circulation.

There seems, in many respects, to be a very intimate connection between respiration and digestion, and a certain balance appears to be established between the nature and amount of the food which we consume, and the quantity of air that we vitiate, and the lungs, as it would seem, in a great measure, serve to counteract the excesses of the stomach. When this organ is oppressed with food, we vitiate the air more rapidly, and respire with

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expire in the space of 6000 years, at 3lbs. per day, we shall find it to be 6000 billions of lbs. or just $\frac{1}{1000}$ part of the whole atmosphere. Now, supposing this doubled, to allow for the quantity of acid which may be supposed to be generated by combustion, we shall then have $\frac{1}{1000}$ part of the atmosphere to be carbonic acid, which agrees with experiments as to the quantity now actually found in it. There is not, therefore, any necessity to believe from the phenomena, that means are used by nature for the restoration of the purity of the atmosphere."—*Dalton on Respiration, &c. Manchester Memoires, new series, vol. 2d. p.* 40.

greater

greater difficulty, particularly when sleeping in close and ill ventilated chambers. Mr. Spalding, whose name is so intimately connected with the history of the diving bell, always found, that when he eat much animal food, he vitiated the air in the bell more rapidly than when he lived on vegetables, and repeated experiments had so convinced him of the fact, that he always lived on the most simple diet when engaged in diving. When we breathe a pure atmosphere, and increase the frequency of our respirations by exercise, we feel an increased appetite, and the healthful tone and action of the stomach is improved. On the other hand, the respiration of impure air acts through the lungs on the stomach, impairing the appetite, deranging the digestion, and debilitating the frame. Mr. Townsend states, that the miners in Cornwall, are constantly affected with a sick stomach, from respiring the impure air of the mine; and the experience of every one will afford similar instances of the sympathy between the stomach and the lungs. It is also a fact, that a deranged stomach is one of the first symptoms resulting from the respiration of an infected atmosphere, which proves still farther, the connection which exists between these organs.

When we sleep in a confined and ill ventilated bedchamber, we generally rise in the morning languid and unrefreshed with head-ache, white tongue-dry mouth, and other symptoms, indicating imperfect digestion. I have, in different instances, met with persons thus circumstanced, who, after having in vain tried a variety of medicine, with a view of relieving what they were taught to consider a bilious stomach, found all these unpleasant appearances removed, by breathing in a well ventilated bedchamber the pure and refreshing air of the country.—The stomach and the lungs

lungs perform equally essential offices in the sustention of health and life, and between the purification of the blood in the lungs and the digestion of food in the stomach, there is an inseparable sympathy or mutual influence by which an admirable balance of power is preserved in these two essential organs.—The blood nourishes and sustains all the solid and fluid parts of the body, and contributes also to the reproduction of parts decayed or lost—it is the general fluid from which all our secretions are elaborated, and it affords also a constant and necessary stimulus to the brain and nerves, as well as to the heart and vascular system. From these, as well as many other important purposes answered by the blood in its course through the body, it must be evident that the health and vigour of our system depend on the purity of this great fountain of life; and this most essential object is no less accomplished by respiration than it is by digestion. Air and aliment being the two great and indispensible requisites of life, the healthy constitution of the animal frame depends on the conjoint supply and purity of these two great supporters of life. If a regular supply of chyle be necessary to replenish the blood, so as to enable it to continue the performance of its important duties—a regular supply of pure air is equally essential to assist and perfect the operation of the stomach. If digestion convert food into chyle, respiration converts chyle into blood; and while the stomach is engaged in recruiting the general mass of the circulation with fresh supplies, the lungs are employed in the equally essential offices of freeing it of its impurities, and in fitting it for the sustension of life.

Animal Heat.

But the abstraction of carbon from the blood, and the sanguification of chyle are not the only advantages derived from respiration; notwithstanding some recent and very ingenious experiments,* we are still warranted in concluding, that the *temperature of all animals depends on this function.* Among the many wonders, exhibited in that peculiar organization which constitutes animal life, there is none more calculated to excite our surprise and attention than that power by which animals, under every variety of climate, are enabled to preserve an uniform temperature. The heat of unorganized bodies is governed by the temperature of the surrounding medium. Animals possess an *internal* power, by which they preserve an uniform heat under all circumstances. The human body is of the same temperature under the frozen climate of the polar region, as in the burning atmosphere of the torrid zone; and all organized bodies have a temperature peculiar to themselves, independant of the medium in which they live.—The entire business of the living system consists in an assimilation of new parts, and in the dissipation of those already formed. The ultimate effect of all these operations is chemical change, and these changes produce heat. The animal temperature is caused by the chemical combinations, effected by the blood in its course through the body; the whole nourishment of our system goes on in the extreme vessels, and consists in a continual formation of new parts, the absorption

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* See Mr. Brodie's Papers, published in the Philosophical Transactions for 1811 and 1812.

of

of others, and the various deposition of the substance of bone and muscle. The blood is the agent of these unintermitting changes, which our bodies are perpetually undergoing; and there are many facts to prove that RESPIRATION is the immediate agent by which the blood is enabled to effect these changes, and thereby to sustain the animal temperature.* It has been long known that

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* The most successful opponent of this doctrine is Mr. Brodie. He found, that when artificial respiration is kept up in the lungs of animals, after decapitation, the usual proportion of carbonic acid is formed, and the circulation continues nearly as usual. Yet, in these animals, the heat *diminishes* more rapidly than in a dead animal, in which artificial respiration is not kept up. From these experiments Mr. Brodie concludes, that the production of animal heat is owing to the action of the brain, and not to respiration.

The very ingenious experiments of Mr. Brodie have *completely* subverted the theory of Dr. Crawford; the foundation of which were before considerably shaken by the experiments of Dr. J. Davy, and those of Delaroche and Berard. The former shewed, that the difference between the specific caloric of arterial and venous blood is considerably less than Dr. Crawford had estimated it.

Arterial blood, - -	0·913.
Venus blood, - -	0·903.

Delaroche and Berard have shewn, that the specific caloric of oxygen gas, and carbonic acid gas, differs much less than Crawford had supposed. According to them, the specific heat of these gasses is as follows:—

Oxygen gas, - -	0·8848.
Carbonic acid gas, -	0·8280.

Such minute differences would hardly admit the application of Dr. Crawford's explanation.

But I should suppose Mr. Brodie has gone too far when he asserts that respiration has no connection whatever with animal heat.—The fact that all animals which respire regularly are hot blooded, while amphibious animals and fishes are cold blooded, seems to establish a necessary connection between respiration and animal heat, though we are unable to explain in what manner the heat is evolved. Mr. Brodie, however, has

that those animals, which respire most, possess also the warmest temperature, and are called *warm-blooded animals.* Fishes, frogs, and other creatures, whose respiration is imperfect, enjoy a temperature very little superior to the medium in which they live: they are therefore called *cold-blooded animals.* The temperature of the human body usually remains at 98°. Birds who breathe in proportion, a still greater quantity of air than mamiferous animals have a temperature equal to 103°. or 104°. and there is sufficient evidence to shew, that the temperature of all animals is proportional to the quantity of air which they breathe in a given time.—From these several facts, we must be still more strongly impressed with the dependance of health on the state of the air which we breathe, and why those who possess the most ample chest and lungs, enjoy the greatest degree of muscular strength, and why those who take most exercise and breathe the purest air, have the most florid blood. Exercise and muscular exertion compress the veins and impell the blood with increased vigour, and accelerated rapidity to the heart, which consequently become more stimulated to action; the respirations become more frequent, and the blood more oxygenated.

Thus the same function that purifies the blood and fits it for the purposes of life, is also conducive to muscular strength and energy, and in *conjunction with the nervous system,* affords a perpetual supply of animal heat. From whence we may

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has had the merit of opening a new view with respect to the causes of animal temperature, and his experiments have demonstated that it is considerably under the influence of the brain and nervous system.

truly

truly say, that the blood in its passage through the lungs, acquires, as it were, a new life, becoming more enabled to stimulate the heart to action, to convey the exciting power to all the muscles, and to distribute nourishment, irritability, heat, sensation and life, in its course through every part of our frame. When therefore, we consider the deterioration which the atmosphere suffers from crowding people together in places imperfecly ventilated, when we reflect on the importance of respiration, not only to health but to life: that while we can exist for a considerable time, deprived of every species of nourishment; life is at once destroyed by the suspension of a very few respirations, we must be still more strongly impressed with the vital importance of a full and perfect system of ventilation, and of the necessity of procuring in our apartments an unintermitting supply of fresh air.

Vitiation of the atmosphere, by animal effluvia.

In considering the different agents that impair the salubrity of the atmosphere, it will be found that the most injurious properties of confined air, are caused by the suspension of animal effluvia. The human body exhibits a perpetual series of changes and decompositions: it is constantly acted upon by external agents, and it is constantly imparting to the surrounding atmosphere, a great variety of animal exhalations. Many of the organs which compose our wonderfully complicated frame, are employed in discharging part of the constituents of our bodies, which by the various exercise of its functions

tions are become useless, and if retained would become noxious.*

F Great

* Mr. Cruikshank introduced his hand into a glass jar, and tied a bladder fixed to the mouth of the jar round his wrist.—In less than a minute the inside of the bottle was rendered dim, as if it had been held over the steam of warm water; small drops appeared in less than ten minutes, and a tea spoon full of a transparent fluid, weighing 30 grains was collected in an hour: assuming that the hand is to the whole body as 1 to 60, and that the whole surface perspires equally, the exhalation at this rate would be 7 lb. 6 oz. in 24 hours.—When the experiment was made after taking exercise, 48 grains were collected in an hour, which is at the rate of 12 lb. in 24 hours. By breathing into a bottle for an hour, this gentleman collected 124 grains of insipid transparent fluid. The produce in 24 hours at this rate would be 6 oz. 1 dr. 36 gr. Bichat says he collected 2 oz. of fluid by breathing for an hour into a vessel. Mr. Abernethy collected from his hand and wrist, inclosed in a glass jar for six hours, about 3 dr. of fluid, he estimated the surface from which this was collected at $\frac{1}{20}$th of the whole body: hence if the perspiration be equal at all times and in all parts, the produce in one day would be about $2\frac{1}{2}$lb.

The method employed by Lavoisier and Seguin, is calculated to afford results more worthy of confidence. The whole body was inclosed in a silk bag, varnished with elastic gum, impenetrable by air or moisture, having a small opening carefully cemented round the mouth, through which the person might breathe; so that whatever came from the lungs escaped, while the whole of the cutaneous discharge was confined within the bag. By weighing the body, before putting on this dress, and immediately after leaving it, the *total* loss by the pulmonary and cutaneous discharges was ascertained. By weighing the dress, the quantity discharged by the skin was ascertained; which substracted from the total loss sustained by the body, gave the amount of the loss by respiration. From repeated trials performed in this manner, Seguin and Lavoisier found the mean loss, by the cutaneous and pulmonary discharges to be about 18 gr. in the minute, or 2 lb. 13 oz. in 24 hours. The pulmonary discharge amounted to 15 oz. so that there remain 1 lb. 14 oz. as the mean quantity of daily perspiration.

Our next object of inquiry is the composition and properties of the cutaneous exhalation: It cannot be doubted, that the greater

Great difficulty exists in accurately estimating the amount of the discharge from the surface of the body.——The results of the experiments of Dr. Hales, Lavoisier and Dr. Thompson, give about 29 oz. per day of watery vapour, dis-

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greater part of the matter of perspiration is pure water, it certainly consists of other matter also.

Its sensible properties are evident on coming from the open air into a crowded room: it causes the peculiar odor of the body, which is even very remarkable in some individuals, and possesses peculiar characters in whole races of mankind. The dog is enabled by this peculiar odor, to trace the steps of his master. The exhalation is often sour, and it will change vegetable blue colours to red. From the strong odour of perspiration when profuse, and from the tinge which it communicates to linen, there is reason to believe that it contains a peculiar animal matter.—Human sweat, according to THENARD, is formed of a great deal of water, of free acetous acid, muriate of soda, an atom of phosphate of lime and oxide of iron, and an inappretiable quantity of animal matter, which approaches much nearer to gelatine than to any other substance.

Cruikshank's experiments clearly prove that an oily matter is secreted from the skin: he wore the same vest of fleecy hosiery for 3 months night and day, during the hottest part of the summer. At the end of this time he found an oily substance accumulated in considerable masses, on the nap of the inner surface of the vest, in the form of black tears. When rubbed on paper, it made it transparent, and hardened on it like grease.—It burned with a white flame, leaving behind a charry residuum.

Besides the condensible vapour discharged from the skin, it has been asserted that gaseous fluids are also emitted from it. According to the experiments of Mr. Abernethy: a hand introduced into a glass jar, filled with mercury and inverted, gave out in small bubbles from every point of its surface, one half ounce measure of air in 16 hours. Two thirds of this gas was absorbed by lime water. Mr Cruikshank found that a lighted taper introduced into a bottle, in which his hand or foot had been confined for some time, burned dimly; and lime water agitated in it was rendered turbid. Spallanzani from a series of elaborate experiments, concludes that air in contact with the skin undergoes the same changes as are effected in it by respiration, that carbonic acid gas is exhaled, and that oxygen is absorbed.

charged

charged from the lungs by respiration. Many experiments have also been made to ascertain the amount of matter perspired through the skin; the most remarkable of which are those of Sanctorius, who continued them through a period of 30 years. The quantity of matter discharged from the skin must necessarily vary according to circumstances. It is influenced by the quantity of fluids which we consume, and it is greatest after exercise and in warm weather. The maximum of matter emitted both from the lungs and from the skin according to the experiments of Lavoisier and Seguin, amounted to about 26·25 grains troy, the minimum to 9 grains, which gives 17·63 grains, at a medium in the minute, or 52·89 ounces in the 24 hours.

Injurious consequences resulting from the respiration of impure air.

Many of these emanations, from the surface of the body and from the lungs, are even in the most delicate and healthy persons in a state not very remote from putrefaction, but in those labouring under disease they are still more injurious and offensive. Under this point of view it is not necessary to recur to crowded rooms for proofs of the impurity of the air, which is usually respired: we need only refer to any unventilated apartment, where two or more individuals contribute to deteriorate the atmosphere, and to respire again and again the air which they vitiate.

When in addition to this, we place before our view, the vital importance of respiration, the ample provision made by nature for the continual exercise of this function, the extensive surface and

delicate texture of the lungs, the intimate and unceasing intercourse between this organ and the atmosphere, the extreme state of division in which animal effluvia are suspended in this elastic fluid, how immediately these minute particles are imbibed by the blood, and with what rapidity they are carried by this incessantly circulating fountain of life to every part of our frame, to exert their destructive influence, contaminating the wholesome springs of life, robbing the cheek of its bloom, despoiling the body of its strength, while by the inhalation of a slow, but insiduous and certain poison, we are still farther shortening and embittering the narrow span of human existence.

If the venom of a poisonous animal, matter of small pox, or of any other contagious disease, be applied to any part of the body, where the cuticle is removed, the virus is immediately absorbed, and produces disease or death: in like manner the constitution becomes affected by any noxious substance received into the lungs. Accordingly we find that infectious diseases are communicated by the respiration of air, impregnated with contagious matter. To a less extent, but still in a degree sufficiently evident, the effects of the respiration of impure air, are manifested in those who habitually respire it. Animal effluvia become more noxious from accumulation and confinement, and the senses of every person who enters a crowded assembly, will at once convince him of their offensive nature; conveyed by the atmosphere to the extensive and delicate surface of the lungs, they act either immediately in producing a violent disease, and suddenly affect the system, like the venom of a poisonous animal, conveyed by the blood: or by continually respiring an air, thus rendered impure, we take into our system a poison, which though slow in its operation, will still produce

produce the worst effects on our frame, and impair the tone and energy of the most robust constitution.

It may be said, how is this reasoning compatible with the fact, that people live with apparent impunity, in ill ventilated places, and if impure air be so destructive to life, how can they continue to exist and enjoy health? But this merely shews the power of the constitution to adapt itself to the circumstances under which it is placed, and to become impervious, even to the action of noxious agents. The inhabitants of some countries, breathe with comparative impunity those unwholesome atmospheres, which produce the worst effects on the constitution of strangers.—Some, even of the most poisonous agents by repetition, become familiarized to the constitution, and even opium and arsenic by custom, appear to loose their primary noxious influence- We see thousands every day, who enjoy perfect health, though living on a scanty and impoverished diet, and indulging habitually in excess; yet no one, from these events, questions the salutary influence of temperance or of wholesome food. In estimating the relative influence of the lungs and the stomach on the animal frame, every fact concurs to prove the superiority of the former. To convince us of this, we have merely to view the poorer classes of society, who, though subsisting on an unwholesome diet, yet enjoy good health while breathing the pure and invigorating air of the country, while the better fed city mechanic droops under the impure atmosphere in which he is invelloped.

When we consider the influence of impure air on our constitution, we must not estimate it merely with reference to the absence of positive disease, nor even to the proper performance of our

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mental and corporeal functions. There are many degrees on the scale of health, and there is a long interval between the degree which marks the full and perfect enjoyment of this first of blessings and the absolute infliction of disease. The great and important question of health must be also viewed with reference to our capacity of accommodating our constitutions, to varieties in temperature, diet, and modes of life, and also in resisting many causes of disease which produce the worst effects on a weakened and less healthy frame.

Impure air contributes, in a very eminent degree, to predispose the human body to be acted upon by disease—it exerts great influence on the stomach, producing loathing of food, and impairing the digestive powers. It is peculiarly injurious to the nervous system, relaxing and enfeebling the general habit, and increasing the morbid sensibility and irritability of the human frame. Those who labour under chronic diseases are frequently depressed and enfeebled by an irregular and slow fever, which, from the impure air, breathed so many hours in bed, is considerably aggravated during the night, and there is no more frequent cause of disturbed and feverish slumbers than the impure air of close and ill ventilated bedchambers.—Females, in particular, whose habits of life are more recluse than ours, owe much of their nervousness and debility to the care they take to exclude the external atmosphere, and from their habitual respiration of a close and warm air, which so many agents have contributed to vitiate.

It is, however, on the tender and susceptible frames of children that these ill effects are most evidently manifested. The respiration of pure air is infinitely more essential to them, even than it is to us, and those who have devoted the most accurate

accurate attention to the diseases of children, have found no difficulty in attributing many of their complaints to the heated, crouded and ill ventilated nurseries, in which they are confined.—Many weak parents are apt to console themselves respecting the diseases and early dissolution of their children, by considering them as inevitable and natural events; but they do not reflect on the possibility of better management, nor attend to the healthier condition of other children, who are reared on a better system. The mortality of mankind, according to the registers kept in all countries, is most remarkable in early infancy; but such mortality is surely contrary to the wise dispensations of Providence, and can only be justly referred to the improper treatment of man. The child is born healthy and perfect; he droops under improper management, and he pines in the close and impure air of his nursery. Constantly confined in its mephitic vapours, he is habituated to too great a degree of warmth, which debilitates his frame, while the constitution is also undermined by the impregnations of the atmosphere he respires. Pure air is the best medicine for valetudinary infants, and greater benefits cannot be conferred on them than by frequently exposing them to its enlivening influence. The truth of this assertion is confirmed by the chearful and active youth of the country, who live in the open atmosphere, and find in it the best preservative against that debility and disease which necessarily falls to the share of those wretched beings, who are almost constantly reared and pampered in a nursery. Pale countenances, weak eyes, general relaxation of body, slow consuming fever and rickets, are the almost certain consequences of such confinement; and every disease to which

they

they are accidentally subjected, is aggravated by the same noxious agent.

It is impossible to visit the usual charitable receptacles for children, and to behold the miseries that prevail in them, without feeling an anxious desire to deliver the poor creatures from the ill system under which they suffer. Children with crooked shoulders and legs, large swollen bellies, unusually large heads, features resembling those of old men; pallid cheeks, sunken eyes, surrounded by a dark or blue ring, loss of the flesh of the legs and arms, destitute of infantile vivacity, all compose the distressing scene, and painfully evince the pernicious effects of a close and contaminated atmosphere.*

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* The following extracts from Dr. Clarke's Paper, published in the third volume of the Royal Irish Transactions, afford, perhaps, the best and most accurate detail of the effects of impure and pure air on children. The registry of the hospital to the present day shews, that the improvements, introduced by this judicious and deservedly eminent practitioner, in its ventilation, produce the same salutary influence on the health of the children as was evinced under his management.—In a late communication to the Board of Health, recently instituted in Dublin, Dr. Clarke states, that the women have not derived the same benefit from the ventilation of the hospital, as the children *continue* to derive from it; and the occasional appearance of puerperal fever in this establishment, (sometimes carrying off, perhaps, fifty, in the course of a few weeks) proves, that lying-in women require, that the *temperature* of the air should be considered, as well as its circulation. Perhaps nothing would conduce more to the health of such establishments, than ventilation by warm air.—It would eminently contribute to absorb and carry off the various effluvia, and preserve the wards in a healthy, dry, and comfortable condition :—

" At the conclusion of the year 1782, of seventeen thousand six hundred and six infants, born alive, in the Lying-in Hospital

Few persons are sufficiently attentive to the beneficial influence of fresh air. All confined places evince the want of it, not only to animal but to vegetable life. In vegetation,

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Hospital of this city, two thousand nine hundred and forty-four had died within the first fortnight; that is nearly every sixth child, or about seventeen in the hundred. The disease which carried off most of the children, perhaps nineteen of twenty was general convulsions, or what our nurse-tenders have been long in the habit of calling the 'nine-day fits,' as constantly occurring within the first nine days after birth. *** I ventured to hazard some conjectures concerning the causes of a mortality by which so many useful lives were lost to the state.

"1st. Foul air, or an impure atmosphere.

"2d. Neglect of keeping the children clean and dry.

3d. Irregularity in the manner of living of their mothers, more especially in the abuse of *spirituous* liquors, were the causes which appeared to me the most probable, either separately, or perhaps combined; but I suspected the first, viz. an impure or phlogisticated atmosphere, for contributing most powerfully to the general calamity.

"First—That public registers proved the mortality of children to increase with the size of the towns; and that the larger towns are, the more numerous, are the causes which have a tendency to taint their atmosphere, and thereby render it less fit for the purposes of salutary respiration.

"Secondly—That in private practice, physicians in the city of Dublin, do not find the mortality of infants, in any degree, so considerable, as our registry proved it to be in the hospital; a proof that there was some peculiar exciting cause of disease."

Here follow some observations relative to the hospital, more particularly with respect to its ventilation:—

"Lastly—I alleged it was by no means inconsistent with analogy or reason, to suppose that the accumulated effluvia, arising from the bodies of puerperal women and children in lying-in hospitals, might acquire qualities peculiarly noxious to the delicate frame of infants. That in other hospitals and gaols, as the pernicious effects of accumulated human effluvia have been often experienced by robust adults, it is possible that degrees of contagion inferior to those, may prove fatal to infants. I concluded with quoting the authority of Arbuth-

we may contrast the diminutive state and sickly growth of the same plant in a confined town-garden, and in an open and spacious field. The greater mortality among the inhabitants of large towns,

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not, who has observed, *That the air of cities is very unfriendly to infants and children; for that as every animal is adapted by nature to the use of free and fresh air, the tolerance of air replete with sulphureous steams of fuel, and the perspirable matter, of animals, (as that of cities) is the effect of habit, which young creatures have not yet acquired;* and that if the air of cities be unfriendly, *a fortiori*, so must the air of hospitals in cities, and in proportion to their want of ventilation."— Viewing the subject in this light, I proposed a number of alterations, intended for the more complete ventilation of the hospital, and for which I was principally indebted to Mr. White's excellent work, on the management of lying-in women. My observations had the effect I wished with Doctor Hutcheson and the Medical Governors. Apertures of a considerable size, were made in the ceilings of each ward, which have been since changed for air pipes, of six inches diameter; three holes, of an inch diameter, were bored, in an oblique direction, through each window frame at top. The upper part of the doors, opening into the gallery, were also perforated with a great number of holes. By these means, a free and easy passage was given to the air, through the wards, at all times, and executed in such a manner, as to put it out of the power of the nurse-tenders or patients to controul. Since the above period also, the number of beds in the large wards has been reduced to seven, and several changes made in their construction, which render them more airy, and more easily kept clean. *The consequences have been favourable far beyond the expectation of every person concerned.* The nine-day fits are become visibly less frequent, and the abstract of our registry shews the fact at first view, to the most inattentive observer.—Of eight thousand and thirty-three children, born *since the above period*, only four hundred and nineteen have died in the hospital; that is nearly one in nineteen and a third, or from five to six in the hundred. Had the mortality of infants been in this proportion since the commencement of the Dublin hospital, the number of children dead would have been somewhat about thirteen hundred, instead of the present number,

towns, and their pale and more sickly appearance when compared with those who breathe the pure air of the country, confirm also the general reasoning.*

These ill effects resulting from the impurity of the atmosphere of large towns are still farther aggravated by the imperfect ventilation, not only of our public institutions, but even of our private dwellings. We are subjected in them to all the inconveniences and ill consequences of partial currents of cold air proceeding from doors and windows; and even this imperfect and inadequate ventilation is, in a great measure, suspended during the night, while respiration is incessant in vitiating the atmosphere, and every breath which we inhale produces its allotted influence on our frame.

If we come from the open air into a crowded room, or an unventilated bedchamber, we will at once perceive the impure and vitiated state of the air with which they are filled; but we disregard the evidence of those sensations, which na-

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number, three thousand three hundred and sixty-three; or, in other words, *above two thousand lives would have been saved to the community.*

"That this diminution of mortality is to be attributed to improvement in ventilation can admit, I think of little doubt. No other new mode of management has been of late practised to account for it. No other remedies used than such as have been used a thousand times unsuccessfully."—*Dr. Clarke's Paper, Transactions of the Royal Irish Academy, 3d vol.*

* "It may be stated in general, that whereas in several towns the proportion of inhabitants dying annually, is from one in 19 to one in 23; and in moderate towns, from one in 24 to one in 28. In country parishes and villages, on the contrary, this proportion seldom exceeds one in 40 or 50. The proofs of this are numerous and unexceptionable."—*Price on Reversionary Payments.*

ture, with a provident care of pointing out danger, has furnished us with, we disregard the still more decisive evidence of the head-ache, langour, oppression, faintings and other inconveniences, which are experienced in theatres, ball-rooms, churches and other crowded places, which are caused by the impure air we are compelled to breathe, in consequence of their defective ventilation.

When, therefore, we consider the deterioration of the atmosphere, which ensues from crowding people together in places imperfectly ventilated, and where it is not only vitiated by respiration and animal effluvia, but by combustion and other causes; and when we consider the importance of respiration not only to health but to life; that while we can exist for a considerable time, deprived of every species of nourishment, life is at once destroyed by the suspension of a very few inspirations; we must be still more strongly impressed with the vital importance of a full and perfect system of ventilation, and of the necessity of procuring in our houses a perpetual supply of a more pure and wholesome atmosphere.—If fashion continues to exert her imperative sway in crowding our apartments, humanity, as well indeed as self-preservation, should prompt us to make a necessary provision, that they shall not become unwholesome from an almost total want of that indispensible pabulum of existence.

Instead of seeking to accomplish this salutary measure, it would appear as if we conspired to stop every avenue to the entrance of this vital fluid; we shut the windows as close as possible, and put list round the doors; fortunately for us, all our exertions to stop its ingress altogether, are ineffectual. To a certain extent, however, we do succeed, and the sensation of every

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one coming from the open air into a crowded room, but still more into a bed-chamber, must at once convince him of the extreme injury which even a healthy person must sustain from respiring so impure an atmosphere.

In the frequent faintings, which take place in close and crowded rooms, and in the pallid and languid faces of those who have passed a few hours in such places, we witness the deadly influence of the unwholesome atmospheres with which they are filled.

If these ill effects result from neglect of ventilation in the residences of the opulent, how must they be aggravated in hospitals, work houses, manufactories and in prisons, where the air becomes still more highly impregnated with the exhalations of the crowds which they contain, where their health becomes undermined by the poisonous atmosphere which they respire, and which they vitiate, and where the most virulent and pestilential diseases are generated, which subsequently diffuse themselves through every class and gradation of social life.

Accordingly, if we review the records of our civil and military hospitals, we shall find endemic or local diseases prevailing in all, that the convalescence of the sick is retarded, that relapses are frequent, that fever is almost invariably communicated to the physicians and attendants, and that numbers in every part of the kingdom fall victims to the foul and pestilential air which they breathe in those crowded and ill ventilated mansions of disease.

If, on the other hand, we inspect the state of our prisons, we shall find in a more remote as well as in the present period, the same disastrous effects, uniformly resulting from neglect of ventilation, and in the constant generation and diffusion

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of fever, and in the squalid countenances of their wretched inmates, we may see the want of that genuine cordial of life, which the bounty of providence so liberally supplies, but which the culpable neglect of man withholds from his fellow-creatures.—It would form an interesting subject of medical inquiry, to trace the influence of impure air on the human constitution, varied as it necessarily is by the concurring influence of climate, age, diet and other agents.

Fever originating from impure air.

The injury we sustain from respiring impure air, is not confined to merely lowering the general standard of health: it is also an active agent in the production of *acute* disease. Every fact concurs to prove, that Typhus fever is constantly generated where crowds of people are assembled together in places imperfectly ventilated: The continual occurrence of fever in the crowded habitations of the poor in all large towns, and its frequent appearance in hospitals, gaols and work-houses, fully prove that foul air is the great parent of this formidable malady.

The authority of the most eminent medical writers, and the daily experience of every physician, concur to prove, that the effluvia of persons crowded together for a certain space of time, in confined and ill ventilated places, is capable of generating febrile contagion, and also, that the contagion so generated is subsequently diffused. Dr. Lind, in his work on the diseases of seamen, records many instances of fever breaking out in a healthy crew, from their being confined below deck without an adequate supply of fresh air.—Amongst a variety of instances, he says, that in the

the healthy crew of a frigate, a malignant fever broke out from "their being confined below in bad weather, without adequate ventilation." Thus (says he) "a seasoned crew, became infected, as it would appear from the closeness or dampness below, occasioned by the hatchways being shut."

Sir John Pringle, in his admirable treatise on the diseases of the army, asserts, "that the close air of hospitals in warm weather, even when they were not crowded, produced fever; and that in transport ships and in barracks, fever is constantly generated from the same cause." Were it my object to multiply facts and authorities * in proof of this assertion, the medical history of the late war, is pregnant with instances of the same kind, and in the writings of Dr. Jackson and others, on the diseases of the army;—we may see, in full detail, the dreadful havoc Typhus has made in our barracks, our transports and in our hospitals.

Febrile infection, from close and ill ventilated places, is a much more frequent occurrence than is generally imagined, and there are few large boarding schools that are not occasionally visited by this disease. When fever makes its appearance in a family, it is frequently not attributed to the true cause from whence it originated, and it is endeavoured to be traced to the operation of external agencies, when it might be found in the close and unventilated state of the dwelling itself. When Typhus fever

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* "It is now known, that the effluvia constantly arising from the living human body, if long retained in the same place without being diffused in the atmosphere, acquire a singular virulence, and in that state being applied to the bodies of men, become the cause of fever, which is highly contagious. The existence of such a fever, is fully proved by the late observations on gaol and hospital fevers."—*Cullen's first lines, page 123, vol.* 1.

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breaks out in a boarding school of boys or girls, as it frequently does, the disease is attributed to causes that are in fact not at all accessary; when a more accurate and just investigation would point out, that they were exclusively confined to the school where the disorder is actually produced; and when it does not appear in the neighbourhood, it must be evident, that it is a local infection, proceeding from causes inherent in the school alone; but unfortunately its true source remains unsuspected, and is consequently unremoved.

In public institutions erected for the children of the poor * where there is necessarily a greater accumula-

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* "The Bedford asylum which is attached to the house of industry, was originally constructed for *six* hundred children, from the age of five to adolescence, but was crowded by a gradual accumulation of eleven hundred boys and girls. Notwithstanding the care of the superintendant, epidemic fever spread continually amongst them. It was surprising how soon, and how generally they contracted *petechiæ*, with great failure of strength, a turgid countenance, and considerable stupefaction. If these cases were not quickly transferred to the hospital, the fever spread, and its charaeter deteriorated. If on the other hand, the patients were timely removed to cool and ventilated wards, and treated with active purging and cold ablution, the fever seldom continued longer than seven days in any case, and hardly ever proved fatal."

"If it be enquired to what causes the frequent generation of fever may be assigned, amongst children who were well clothed and fed, and lodged in dry chambers, I would reply, that a permanent cause existed in the noxious atmosphere of their crowded dormitories, and an occasional or exciting cause in the vicissitudes of the weather. Other causes might concur with these, but that those were the efficient causes is demonstrated by the remarkable fact, that since the number of children has been thinned in the asylum, and their dormitories more effectually ventilated, petechial fevers, and even synochus have almost wholly disappeared. In like manner, a reduction of the number of adult paupers, and a more perfect ventilation of

accumulation of these febrile miasmata; disease consequently manifests itself more frequently.—Our ill ventilated work-houses contribute also in an eminent degree to the generation and diffusion of this formidable malady. *

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of their wards by day and night, have rendered the appearance of Typhus amongst them, of comparatively rare occurrence. The history of other similiar institutions, furnishes corroborating evidence of the facts here stated. It is worthy of remark, that the same circumstances, which tend to the production of typhoid or petechial fevers, in large seminaries of poor children, favour the generation of *scarlatina* in crowded schools of the most opulent classes. The dietary of the former establishments, consists chiefly of farinaceous aliment, that of the latter consists largely of animal food."——*Dublin Hardwicke Fever Hospital Report, for* 1813, 1814, *and* 1815. *by Dr. Edward Percival.*

* "Although a greater number of patients have been received into the house of recovery, during the past year, (1812,) than many of the preceding five years, yet it does not appear that contagion has prevailed generally in any district of the metropolis. The principal source of the increase in the number of patients within the period in question, arose from the introduction of typhus contagion into the crowded workhouse of Shadwell, in October last, from which place 20 infected persons were received.—This instance of the local effects of contagion is worthy of attention, as it demonstrates the facility and the fatality with which fever spreads among the inhabitants of close and crowded habitations, and the success with which it may be exterminated by the means recommended and practised by this institution. A child was taken into the work house in Ratcliff-highway, from a court in the neighbourhood, where fever had been introduced by her mother, who had acted as nurse to a person infected with typhus. The work-house at this time was exceedingly crowded, containing in fact, 208 persons, where only 150 were intended to be accommodated, and the over proportion was considerably the greatest among the children, whence the contagion readily spread in the childrens wards where it was first introduced: and from thence is was soon propagated throughout the work-house, in which every ward except one, had been infected, and several persons (including

War Fever.

Fever is not an unfrequent occurrence from the foul air of crowded and ill ventilated barracks, but when

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(including the matron of the house) had died, at the time when application for assistance was first made to the fever institution, being only a few weeks from the introduction of the fever among them. From that instant, the paupers of the work-house were immediately removed to the house of recovery in Gray's-Inn-lane on the first occurrence of symptoms of fever, and it is a satisfactory demonstration of the advantages of ventilation and extreme cleanliness, that none of the patients so removed died; and that in fact very little medicinal treatment was requisite to aid the effects of these expedients in removing fever."

"The work-house was fumigated and cleansed, and improved by a variety of judicious alterations, under the direction of Dr. Bateman, physician to the fever institution.*** 'This process of purification was successful, for no adult person in the work-house, who had not been already infected, appears to have been afterwards attacked with fever. About six weeks after this, however, in consequence of the still more crowded state of the childrens wards during the winter, (for they slept to the number of six, and in some instances, even eight in each bed, and occupying both ends of it) there was slight renewal of the fever amongst them, and six were sent to the house of recovery, with very slight symptoms of the disease, which did not confine them to bed 2 days, it seemed evident, pure air and cleanliness, were the only remedies which they required: for they uniformly began to recover from the moment of their reception into the institution; and the adoption of those measures, as far as was practicable in so crowded a habitation as the work-house, appears to have ultimately succeeded in exterminating the contagion there: for 3 months have now elapsed, since the last application was made from that establishment."*** "When it is recollected, how rapidly and fatally this fever spread itself into every ward of the work-house, within the short space of a few weeks,—how vain the mere removal of some infected patients to the London hospital, had already proved to check the progress of the contagion——and how readily the convalescent patients were re-infected, several a second, and some even a third

when to this cause of disease are superadded the fatigues, privations and other exciting causes, concomitant on actual warfare, we find whole armies desolated by its visitations.

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third time,—and when it is considered also, in what a close, crowded and uncleanly neighbourhood this work-house is situated, in the centre of a great mass of population, who have neither the knowledge, nor the means of preventing the propagation of contagion among themselves—it may with the highest degree of probability be inferred, that an extensive epidemic fever, and much mortality have been prevented by the measure adopted by the fever institution in this instance."—*11th report of the institution for the cure and prevention of contagious fever in the metropolis*, 1813.

Had the work-house been properly ventilated in the first instance, all the evil would have been prevented.

"During the present month, (April, 1817,) the number of patients received into the house has been greater than were ever admitted within the same period since the opening of the establishment. This circumstance is principally to be attributed to the unusually crowded state of the poor houses of the metropolis, arising from the present distressed condition of the labouring classes of the people. For although a considerable number of the cases of fever have occurred in the private habitations of the poor; yet *the chief sources of contagion* (which have nearly filled the wards appropriated to Typhus in the new house of recovery,) *have been the work-houses*, especially that of Shadwell, from which 16 patients have been received during the last three weeks. Those of Whitechapel, St. Pancras, and St. Sepulchre, have also been more partially inflicted with contagious fever, and have contributed to increase the number of patients now in the house. The patients sent in from the former, (White chapel,) ascribe their fever to the extremely crowded state of that work-house, and especially to the circumstance of some of them having been obliged to lie on the floor for want of room in the over crowded beds. A family consisting of a father, two sons, and a daughter, sent in also by the parish officers of White chapel, believe that the fever was introduced among them from the work-house, whither the daughter, who was first attacked with the disease, had gone for relief."

15th Report of the institution for the cure and prevention of contagious fever in the metropolis, for 1817.

Fever has, in all ages and countries, been the attendant of war. From the earliest records of history we hear of whole armies being suddenly cut off by disease; but the less accurate description of the classics may be passed over, to sketch the pestilential fevers which have occurred during the last centuries.—In 1516, after a severe war, which Maximilian II. waged against the Turks, in Hungary, a most dreadful epidemic arose, which not only afflicted his army, but laid all Germany in waste.—In 1683, a similar pestilential disease followed another war in Hungary, and has been described by Fr. Hoffman.

The French war, in 1740 and 1750, again generated a pestilence with which we are well acquainted, in consequence of the masterly description of Pringle.—The seven years war excited it once more. Frederick the Great, whose piercing eye nothing escaped, and who was so much interested in the *effects* of disease, thus describes it:—"Even the desolation caused by the war, in seven great battles, did not at all equal that produced by the contagious disease in the hospital; it was a kind of ardent fever, which was accompanied with all the characters of the plague."

From the beginning of the French revolution, the commencement of a state of war among the European nations, of twenty years duration, several epidemics have followed each other In the first ten years they prevailed more in the south of Germany and Italy, which was then the seat of war. In the first Prussian war of 1806-7, it broke out in a dreadful degree in Prussia and Poland, the seat of the war. Another dreadful war fever broke out in the French and Prussian armies, in the dreadful winter campaign of 1812.*

ASSALINI

* Of the disease, as it occurred at Torgau, we have an excellent account, by G. A. Richter.—"The disease was first brought

Assalini informs us, that the Pyrenean army, in the second year of the republic, lost, in the space of four months, ten thousand men, from disease, chiefly fever, comprehending in this number, almost all the medical, and other officers, employed

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brought into the fortress by some of the deplorable French fugitives, who returned from their disastrous campaign in Russia. It began in the middle of January, 1813, and prevailed with considerable severity during the whole of April and part of May, and had nearly disappeared by the end of the month, after carrying off many of the inhabitants and garrison. The latter consisted of 10,000 Saxons, under General Thielmann, of whom died, in April, 154; in May, 304; and in June, 76. But when the Saxon garrison was withdrawn, to make way for a large body of French, immediately a much more malignant epidemic arrived with them, *which increased as their numbers increased.*—The garrison consisted of the worst description of troops; few regularly embodied, but made up of the united depots of what was then called the grand army: of all the convalescents from the various hospitals, who were unable to return to duty, and who were formed into provisional regiments There was also a host of *employés* and followers, who were quartered on the citizens, and crowded the place of only 5000 inhabitants very much. At last, all the hospitals of Dresden and the neighbourhood were moved into Torgau, and the events of the war prevented them from being removed farther into the interior. Almost the whole public buildings were converted into hospitals, and were still insufficient to contain the sick, amounting to 6000; and, at last, the inhabitants of whole streets were driven out of their houses to make way for the sick.—Even at this time, in all the hospitals, there raged a malignant putrid typhus, which committed great devastations; at least one-third of those affected died, and many of the French physicians and surgeons fell a sacrifice to their duty.

"Matters were in this state, when after the battle of Donnewitz, on the 6th September, the head quarters of the 3d and 7th *corps d'armée* were moved into the fortress, accompanied by many other fugitives; and, almost at the same time, the principal head quarters of the French arrived from Dresden, by which event, at least 10,000 men and 5000 horses were suddenly thrown into this small town, and the Prussians besieged

ployed in the hospitals. A very malignant fever broke out amongst the French troops, after the battle of Heliopolis, and at the siege of Cairo, attended with a gangrenous affection, to which a great number fell victims.

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besieged it closely. The consequences may easily be conceived ; *Torgau resembled one great hospital, filled to excess with sick.*

" The proper hospitals were in a dreadful state : they could scarcely contain the number of sick, which now amounted at least to 12,000. These miserable wretches were obliged to be so crowded together, that they almost touched each other ; they lay buried in their own filth, and *rotted when still alive.*— The dead were left for days in the same bed with the living, and it was natural, that *in such a place, the slightest wound, or most trifling complaint, proved fatal ; and it was almost pronouncing sentence of death to send a patient into the hospital.* No wonder that the mortality exceeded all belief, for in November 8000 perished !

" Until the beginning of December, the number of sick increased, and in the hospitals alone 300 died daily. Their numbers afterwards began to diminish, owing to all the natives of Germany being permitted to leave the place, and so large a number having already passed through the disease. The inhabitants too were now getting more room, on account of the great destruction of the horses for food or otherwise.— In the beginning of January, it declined more obviously, and on the 10th of the month the fortress was delivered up ; when the number of sick consisted of 53 officers, and 3133 privates. According to the reports, which, however, were not complete, there died in—

	French.	Saxon.	Citizen.	Total.
Sept. ...	1107 ...	64 ...	43 ...	1214
Oct. ...	4803 ...	36 ...	66 ...	4905
Nov. ...	8000 ...	3 ...	437 ...	8440
Dec. ...	4856 ...	— ...	258 ...	5144
Jan. ...	649 ...	— ...	83 ...	732
	19,757	—	887	20,435 in all.

" But there is little doubt that a much larger number perished; not less than 29,000 or 30,000 of the French army in four months and a half, of whom about one-third died of typhus,

The medical history of the late Peninsular campaign, would afford many instances of similar calamity;—without, however, entering into any detail of these disasters, as they occurred in the earlier period of the war, or in the retreat to Corunna,

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typhus, the other two-thirds of a colliquative diarrhæa, resembling dysentery. From Torgau the fever extended to the neighbouring towns and villages, especially in Rosenfelde, *where it caused dreadful devastation.* The Russian army which followed the French, suffering under the same disease, brought it again and again; in the Prussian army it was also constantly generated; so that it became more virulent and general. But the course of the armies, and those countries which were long the seat of war, or of a blockade, suffered the most. From these reasons, in Berlin, Konningsberg and Breslau, where the chief hospitals were established *the greatest number of prisoners were collected, the mortality was excessive.*—From Prussia the disease spread with the progress of the war into Saxony, which, by the concentration of its evils, (crowding people together, without adequate ventilation) *furnished a dreadfully fertile new field for its reproduction*; and from Saxony, it advanced westward.—In October it first appeared at Hannau and on the banks of the Rhine; in December in the south of Germany and Wirtemberg; first in the north, then in the south. Typhus fever accompanied the allies to Paris; soldiers were received into their hospitals, for the first time, on the 9th of February, 1814, and the disease so well known under the appellation of typhus, or gaol, or hospital fever, spread, *as usual,* among the attendants."

Description of the Epidemic disease of Brün, after the battle of Austerlitz, extracted from Baron Larrey's Memoirs of Military Surgery.—It affords a most striking exemplification of the danger of crowding people together without adequate ventilation:—

"We had scarcely collected together in the town of Brün, the wounded of the French and Russians, the number of which was very considerable, when an epidemic disease broke out amongst them, which was recognised to be the putrid, nervous malignant fever, (*adynamico-ataxique*), or the contagious typhus of the antient nosologists. * * * The wounds, the suppuration of which, at first, diminished, put on a putrid appearance, and this gangrenous affection afterwards made a very

Corunna, it will be sufficient for our present purpose, briefly to advert to them, subsequently to Sir James Macgrigor's arrival in the Peninsula, in 1811, from whose excellent history of the diseases of the army from that period to June, 1814, I shall make a few extracts, in proof of the fatalities resulting from crowding people together in places inadequately ventilated.

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a very rapid progress * * *. It was in this last stage that the wounds put on the true gangrenous character, and diffused to a great distance a most fetid odour. The miasmata produced by the secretion or purulent exhalation of these ulcers, were extremely contagious; and the patients in the vicinity of those attacked with the epidemic, even the medical men who attended them, had to fear, in an extraordinary manner, the invasion of the disease. In short, the wounded men, in the same wards, were not long before they experienced the same symptoms. The evil propagated itself from one to another, infected the hospitals and neighbouring houses in succession. * * * The removal of the patients also contributed to the progress of the contagion, which spread in such a manner, that in less than a month, the hospitals of the line had lost more than a fourth of their wounded. * * *

" *The hospitals of the fever patients became crowded in a short time, and the mortality was likewise proportionally great.* The epidemic appeared at the same time amongst the Russian prisoners, which we had been obliged to crowd together, in great numbers, into the churches and other large buildings. Lastly, it was not long before it began to spread amongst the inhabitants, and extended itself in the end, along the whole line of evacuation to France, by means of the removal of the sick of both nations, and of the prisoners * * *.

" This epidemic was scarcely felt by the wounded men of the Imperial guard, whom I had placed in the *hospital de la charité*; it was at a distance from the other hospitals, isolated from the populous quarters of the town, *well ventilated*, and in excellent repair. *We lost here but few of our wounded or fever patients.*

" The causes of this epidemic may be looked for in the fatigues and privations which the troops of both nations had undergone, in the vicissitudes of the weather, *the crowding together*

In selecting this period for illustration it must appear that I am not influenced by any desire to give an over-charged picture of disaster. It is stated that his Grace the Duke of Wellington placed full confidence in the chief director of the army medical department, "and confided to him the uncontrolled direction of every thing that related

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gether of the prisoners, wounded and sick, of both armies,"(a) in the bad diet and state of forced inaction in which these troops were obliged to remain after such long, rapid and fatiguing marches * * *.

"As the fatal progress of this kind of epidemic was foreseen, every measure was taken to hasten the departure of the prisoners of war for France. Afterwards the evacuation of the sick and wounded took place; they were transferred to Vienna, where *large hospitals* were preparing for their reception. The temperature of the atmosphere, moreover, changed; which, joined with the removal, change of place, and the attentive care which they received, arrested the progress of the epidemic and diminished its effects.—From this moment the wounded men proceeded hastily to recovery, and the wounds of almost all the French sent into this town were perfectly cured.

Amongst the wounded Russians and the prisoners of war, the epidemic continued to rage until their arrival in France. This obstinacy of the disease was owing to the want of cleanliness of these persons, notwithstanding all the care and attention they received from the French assistants of the hospitals. It was owing likewise to their state of apathy and unconcern, as well as their being *so crowded together in all the places where they halted* on the line of evacuation. These places, however large and numerous they were, were always insufficient, on account of their bad distribution, and of their great numbers. It was without doubt the same reason why our own sick and wounded were not received into separate accommodations along the same line of evacuation. The mixture of persons, which consequently took place almost every where, propagated the disease from one nation to another, and caused the epidemic to extend throughout the whole line of march. This melancholy event might have been prevented, if from Vienna to France, as I then hinted, two lines of evacuation, by two different routs, had been established."—*Larry's Memoirs of Military Surgery.*

to the sick and hospitals."* From the excellent regulations adopted, and the well arranged system which pervaded the entire of *this most important branch* of military service, it is evident, that our illustrious commander evinced his usual sagacity in placing this perfect reliance on Sir James Macgrigor. At no period of our history did military surgery stand higher than during our late arduous and glorious warfare, and "in the encouragement which he (the Duke of Wellington) gave to the medical department of the Peninsular army, by cherishing their exertions, and above all, by gratifying them by that public notice and applause which had hitherto been confined to the military† ;" he evinced that the same splendid genius, which rescued Europe from the bonds of a ruthless despotism, and which raised the military renown of these countries higher than it was at any former period of their history, rightly comprehended also in their full extent all the minor details of military service.‡

In

(*a*) Quere should not the epidemic be attributed *chiefly* to the operation of the above cause. The Imperial guard shared in all the disasters of the campaign, they seemed *alone* to be indebted to their security, to the secluded and well ventilated hospitals in which they were placed ;—it appears also, from the conclusion of the narrative, that as the sick and wounded ceased to be crowded together, the progress of the epidemic was arrested.

* *Sir James Macgrigor's Medical Sketch of the British Armies.* † *Ibid.*

‡ " The confidence the Duke of Wellington reposed in Sir James Macgrigor, the Inspector General of military hospitals, in the Peninsula, in giving him the uncontrolled management of the department, enabled him to enforce the strictest military discipline amongst us. * * * The good effects of this system are strikingly exemplified in referring to the state of the army from the battle of Salamanca, in July, 1812, to that of Vittoria, in July, 1813. * * * It is a fact, well ascertained, during

In the few extracts * which I have made from the " sketch" of Sir James Macgrigor, it must be sufficiently evident that a much greater degree of

 mortality

during the last century, that the retreat of a British army, for any distance, has always been disastrous, and followed by an almost total disorganization of the troops, who, *from disease, became incapable of service for many months.**** During the retreat from Burgos, the whole of the usual causes of disease were in operation. *** And here the value of a medical department, guided by a vigorous hand, and having emulation for its basis, was eminently conspicuous." ***—Here follows the official return, from which it appears, that the number of sick and wounded, from the 20th of September, 1812, from the siege of Burgos, to the 20th of July, 1813, after the battle of Vittoria, amounted to 95,348, including 12,093, in the hospital, on the 20th of September, 1812; of this number, 81,076 were discharged—6,493 remained in the hospital, and 7,779 died.—" The number of sick in the months succeeding the retreat, viz. December, January and February, increased, and the loss was proportionably severe; but the great exertions made to restore the troops to health, had the desired effect, and the army took the field in May, 1813, in the healthiest possible state. The number of sick being under 5000, or one-tenth of the effective force; and of this number half were convalescent. For twenty-four successive days, the army marched towards Vittoria, fought the battle so named, and was within one month after it, within thirty men as strong as when it fought the battle; and this without receiving any reinforcements from England; a proof of the excellence of the military and medical arrangements, and of the uncommon attention of the whole medical officers of the army.

" Without attempting to detract, in the slightest degree, from the foresight or ability of the arrangements of the military departments of the army during this, or any other period, I contend that they would have been insufficient to keep it effective in the field without that spirit of emulation and attention to duty had existed in the medical department, and without which a British army can never be maintained efficient."—*Guthrie on Gunshot wounds.*

* " On reference to the returns of the sick and wounded, I find that from the 21st of December, 1811, to the 24th of June, 1814, that 346,108 cases of disease or wounds, were

mortality occurs in our military hospitals and encampments, than would take place were they less crowded or more efficiently ventilated. We find the director of the army medical board frequently stating, that fever was communicated in the hospitals

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treated in our hospitals. There appeared to have been discharged cured from the hospitals, during this period, 232,553. There were invalided, as no longer fit for active service in the field, or sent to England, 4586, and there died of their wounds or of disease, 18,513."

" In January, 1812, fever made great havock in all the general hospitals. At Cuidad Rodrigo, Dr. Neale informed me, that the cases of Typhus, had almost universally mortification of the lower extremities, with livor and mortification of the nose. This contagious fever soon seized on all the ward-masters, nurses and orderlies, and Dr. Neale himself excepted, upon every one of the medical officers attending the hospitals." ** Drs. Emerson and Bone give a similar account of the hospitals at Celorico, ** and the statements of Drs. Tice, Mosely and Erly, of the appearance of such cases as reached Coimbra, are to the same effect; but it was at Viseu, that most of the disease was seen: The fever in the hospitals at Viseu, *was evidently rendered virulent by the admission of the sick of the guards, and attended as Dr. C. Forbes says, with a mortality, which he had seldom seen equalled in the West-Indies, in its most sickly times.*"

" From Passages, the sick and wounded were sent occasionally by sea to Bilboa and St. Andero. As transports are but ill accommodated for the conveyance of the wounded men, or those labouring under dysentery or fever, and as the season was very unfavourable on the North and East coast of Spain, they often suffered a good deal on the passage; hospital gangrene spread;—cases embarked as Synochus, landed as Typhus icterodes."

" In October, phagedenic ulcer or hospital gangrene, as it is termed, spread widely among the wounded." **

" Hospital gangrene was very prevalent in some of the regimental as well as in the general hospitals. After the battles of

hospitals from the patients to each other, and to the nurses and attendants; and that the dysentery also became contagious; that hospital gangrene committed great ravages; that the number of sick and wounded in the hospitals from December, 1811, to June, 1814, amounted to 346,108, and that of this number, there died of their wounds or of disease, 18,513. That the number of patients admitted into the *regimental* hospitals alone, with Typhus remitting and continued fever, amounted to 45,980. That the mortality from these respective forms of fever, both in the general and regimental hospitals, amounted to 6432.——That upwards of 500 died of gangrene, and 4717 fell victims to dysentery: these being the diseases of an army over which impure air manifests the most evident influence.

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of Vittoria and Pampeluna, it spread widely, and committed great havock in the hospitals at Vittoria, Bilboa, St. Andero, and Passages."

" After the rains had set in, in September, dysentery, the scourge of armies, appeared in our hospitals; and other diseases were observed to have a great tendency to terminate in this the most fatal of all."

" Dysentery was a frequent and fatal disease in our hospitals in the Alentajo from October, and throughout the winter. *It proved fatal to patients recovering from other diseases,* and particularly those who from wounds had been a long time in the hospital. In the hospitals at Alta de Chaô, Abrantes and Santern, *the changes from intermittent to dysentery, were very common.* * * Dysentery was the disease which produced the greatest mortality in the army. * * We lost altogether by this disease, 4717."

" In the medical history of armies as well as of fleets, it will, I believe, be invariably found, that troops *coming into cantonements* after an active campaign, even under favourable circumstances, have very rarely, if ever, been found healthy."—*Medico-chirurgical transactions, vol.* vi. *Sir James Macgrigor's sketch of the medical history of the British armies in the Peninsula of Spain and Portugal.*

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After detailing this frightful scene of mortality and of disease, we are told by Sir James Macgrigor, and I doubt not with perfect truth, "That he had reason to believe, that the practice in the general hospitals, was on the whole, at least, as successful as it hitherto has been in any military hospitals.—That the British army never possessed so great a proportion of high professional talent, and never more ardent zeal in the discharge of duty, than were displayed by the physicians and surgeons in the general hospitals in the Peninsula," and "that the general hospitals were in as perfect order as hospitals ever were." It is but just to add to all this, that from the publications of the army medical men, as well as from the detailed statements given to the public by Sir James Macgrigor himself, it appears that the duties of inspector general of hospitals, were at no period more efficiently or judiciously exercised.

It becomes therefore an important object of inquiry, to ascertain the causes of this great degree of disease, which no care or skill on the part of the medical department of the army has been enabled to prevent, and which in its consequences has added so considerably to the expenses and horrors of war.

In presenting however, this general statement of the uniform production and diffusion of fever and other diseases amongst armies, it is very far from the Authors intention to assert, that these calamities were caused by the agency of close air *alone*. * Every medical man must be aware, that many

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* I should be sorry to be considered so infatuated with the ill

many other agencies contribute to their production, and that particularly when troops are in actual service, exposed to the vicissitudes of the weather, to the impression of the night air, harrassed by fatigue, enervated by defective diet, depressing passions, watching, cold, wet and other evils inseparable from warfare, it would be next to a miracle, should not fever and dysentery frequently make their appearance amongst them.—It is however equally certain, that these concurring causes become more active, when combined with the influence of air contaminated by crowds of people, congregated together in places inadequately ventilated, and it appears, that the generation and diffusion of fever proceed *pari passu* with this cause. So constantly does fever make its appearance under these circumstances, that when troops are scattered in *small* cantonements, this disease rarely occurs, and that it is in towns and close encampments, *where many of the other exciting causes are absent*, that it is most general and destructive.

The hospitals and residences of our soldiers abroad, necessarily participate in the imperfection of those at home: occupied according to necessity, and held by a precarious tenure, it cannot be expected that their internal regulations should be perfect in every respect, or that they should receive an adequate circulation of air, when

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ill effects of impure air, as to attribute every disease, or even fever itself, to its operation alone: having before me the anecdote recorded by Sterne, of a Dr. Baynard, "who being a great enemy to blisters, imagined that half a dozen of them would draw a man to his grave as surely as a hearse and six; rashly from this, contended, that the devil himself was nothing in the world but one great bouncing cantharidis."

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even our civil institutions of a like nature, evince the same defects. Were the ventilation of our hospitals and encampments abroad *specially* attended to, there can be no doubt that the health of the troops would be better preserved; that the recovery of the sick would be eminently accelerated, that the progress of disease would be considerably circumscribed, and that the *war fever*, at least in its usually destructive and pestilential form, would cease to desolate our armies.

Our barracks at home participate in the maladies already enumerated, and when we inspect the crowded state in which they usually are, we cannot be surprised that Typhus is a very frequent attendant upon them.

From the highest authority on the diseases of the army as they now exist, we learn that "Pneumonia both in barracks, as well as in active service, is one of the most frequent diseases of the soldier, it prevails, (says Sir James Macgrigor,) more among soldiers than in civil life: it seldom in England affects the other inhabitants, as it results from sudden or incautious exposure to cold, *after breathing for some time, the debilitating or vitiated atmosphere of a confined ill ventilated quarter, or crowded barrack room.*"

With so many facts before us of the generation of disease in our barracks, and with such a variety of concurring testimony from the most competent and respectable medical authorities, that these diseases proceed from the foul and contaminated air which they contain; it surely cannot be questioned but that *a general and well systematised* ventilation of these establishments would eminently contribute to the health of the soldier, and that in the prevention

vention of disease and in the preservation of life, it would be even a measure of œconomy, leaving altogether out of our consideration, the higher and more influential claims of humanity.

Hospitals.

If these ill effects result from the accumulation of animal effluvia, in places where the healthy alone reside, how must they be aggravated in hospitals where the air is still more vitiated by the respiration of so many diseased individuals, and by the various emanations with which the atmospheres of these over-crowded buildings are constantly surcharged. —If we visit an hospital, even after the windows have been sometime opened, our own sensations will at once inform us, of the impure effluvia with which these receptacles of disease, are constantly filled, but were they to be visited in the evening, during the night, or in the morning, before they have been cleaned and ventilated, we would be still more sensible of the extremely impure and offensive atmospheres, which their inhabitants usually respire. Yet there are no buildings that require a more active ventilation, whether we consider the medicinal properties of pure air, the injurious consequences, more particularly to the sick, from respiring this fluid in a vitiated state, and the many causes that contribute to its infection in these receptacles of every species of disease. If even the cleanest and healthiest individual vitiates the air that surrounds him alike, by his breath and by the effluvia emitted from the surface of his body, how much more must it be injured by the respiration and effluvia emitted from

the diseased inmates of a crowded hospital: many of them afflicted with ulcers, suppurating and gangrenous sores, which pour their effluvia into the atmosphere, while the diseases of others give to their humours a still more putrescent and infectious character, and contribute in a still higher degree, to poison the atmosphere into which they are discharged.—In a room, whose atmosphere is thus contaminated, the matter becomes constantly deposited on the walls, the floors and the furniture; the bed clothes acquire a strong impregnation from the perspiration of the night, and the evil is aggravated during the day, by the patients remaining in the room where they slept.——The bed clothes and bed are prevented from being aired; and the walls and the furniture of the hospital retain the offensive and injurious matter which they have imbibed, and thereby contribute to render still more impure, the already vitiated atmosphere: while from neglect of ventilation no means are taken to remove it, it becomes so contaminated that individuals on coming from the open air, breathe it with reluctance and disgust.

We are taught by the most ample experience, that the most powerful remedies, and the best methods of cure are unavailing, while the sick breathe an atmosphere which is literally rendered nauseous and disgusting, loaded with morbid effluvia, noxious secretions, and the exhalations of the diseased.

Ventilation, which on all occasions contributes so much to general health, becomes of the first importance in the recovery of the sick, to dissipate their morbid steams, and prevent the accumulation of their infectious effluvia:—Those who have been themselves confined by illness in their chambers, and who have subsequently, when convalscent,

valescent, been enabled to breathe the pure air from an open window, and have felt this grateful fluid play on their parched and feverish skin, will require no argument to convince them how much the recovery of the sick is retarded in the fœtid air of our hospitals, and how much their convalescence would be promoted by refreshing them with an adequate supply of a more wholesome atmosphere.

It is in surgical cases, that the utility, and indeed necessity of hospitals is most clearly evinced. In diseases where the general health is merely injured, nature frequently will of herself effect a cure, and the benefits derived from the physician are not so decidedly manifested, nor does his assistance appear to many, to be so evidently required, as when the occurrence of a wound, a dislocation or a fracture leaves no alternative, but the manual assistance of a surgeon. Yet it is precisely in these diseases, that the bad effects of hospital air are most injuriously displayed, varying of course with the nature and seat of the injury, the degree of inflamation and the condition of the parts, which have suffered.

The pernicious effects of air impregnated with animal effluvia are strongly manifested in fractured sculls, and in all injuries of the head, and comparative observations of similar events in hospitals, and in places abounding with pure air, afford the most unequivocal testimony of what has been advanced. Even under the most favourable circumstances, these accidents are lamentably fatal, agravated as they are by the disorder of the brain and nervous system, which is subsequently produced; but the evil is almost uniformly fatal in the mephitic vapours of an hospital. *

* " The ill air of an hospital is more fatal to the re-union of the scalp, than either the bruising of the scalp, or the injury

All injuries which produce a great destruction of substance and supervening suppuration are considerably aggravated by impure air, while they also contribute in an eminent degree to contaminate this fluid. When the powers of nature are vigorous, the separation of mortified substance will be safely effected without injuring the adjacent sound and healthy parts; but when the constitution is broken down, the fluids depraved, and the solids relaxed, by living in the morbid air of

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jury or contusion of the bone. The air of the hospital, the Hotel-Dieu in Paris, is more noxious than the climate of Cremona, Florence or Mantua, and has been a matter of regret in all ages. The good old surgeon Saviard shews us what danger there is in making the slightest incisions, none but those, says he, who have experienced the malignant influence of the Hotel-Dieu (incontestibly the most crowded hospital in Europe,) can imagine the ill effects it has upon the constitutions of wounded patients, causing even the slightest wounds to become mortal. This hospital, mentioned in all periods, as the most foul and pestilential congregation of vapours, is now (*'partially'*) reformed. Saviard, the oldest surgeon of this hospital whose works have come down to us, thus warns those who may succeed him in his office. Paree still more impressed with the same danger, and struck with the ill success of these operations, proposed that an hospital should be erected in the suburbs, in a more healthy air, for the reception of those wounded in the head. La Motte speaks with compunction and penitence of the bad lessons he had learnt in the Hotel-Dieu, and of the ill success proceeding from the malignant air. Petit complained of the mortality in his time, and Dessault, the last surgeon of the hospital, found himself so unsuccessful, that he renounced at last all thoughts of operating in fractures of the scull, and with a few ordinary precautions and remedies, abandoned every such case to nature."—" Without having the misfortune to have served in any hospital, where to use the language of Saviard, I saw innumerable victims, or being driven to absolute despair, like Dessault, and abandoning all hopes of being useful in wounds of the head, I have yet learnt a degree of *caution*," that is, of operating in such cases in any hospital however airy it may seem.

John Bell's principles of surgery.

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an hospital, mortification proceeds with more rapidity, and the separations are effected with greater injury to the surrounding parts.

The same cause renders the discharge from wounds and ulcers more abundant and depraved, and the matter discharged into the atmosphere from these extensive suppurating surfaces, is received along with the atmosphere into the lungs, by which means the injury is still farther increased till a slow consuming hectic terminates the scene.

In ulcerated sore legs, the effects of putrid air are evident in aggravating the original cause of complaint, and these ulcers,after they have resisted every plan of treatment in crowded hospitals and in fact, become worse from the effects of the air which they contain, have healed in a short time after they have been discharged from it as incurable.*

The ill effects of the impure air of infirmaries, are equally manifested on the wounds made in surgical operations; the symptomatic fever and suppuration attending them, are so considerable, as to render the use of the knife, even when most judiciously employed in many cases doubtful, and in some respects fatal. Many operations which are performed with almost uniform success in private practice, and in county infirmaries, are frequently fatal, and almost always dangerous in the crowded

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* People are not aware of the great expense which these institutions incur, from those tedious ulcers which are preserved and produced by foul air and which baffle the most skilful treatment, notwithstanding the liberal use of wine and bark. So that in fact, ventilation, considered abstractedly, would be a measure of œconomy. By accelerating the recovery of the sick, and multiplying the benefits derived from hospitals, in obtaining through them a quicker circulation of patients, it would be one also of humanity.

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and ill ventilated hospitals of Paris and other large towns: * evidently shewing that the salutary influence of pure air is of the first importance, in the success

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* This statement of the proportion of deaths in the four following hospitals in Paris, from 1804 to 1814, is extracted from Dr. Clarke's medical notes, and taken by him, from a work entitled 'Rapport fait au conseil general des Hospices par un de ses membres sur l'etat des Hospitaux."

HOTEL DIEU, containing from 1500 to 2000 patients,

Remaining in the hospital, 1st January, 1804, ...	834
Admitted during the ten years, ...	101,595
Total, ...	102,429
Of this number died in the ten years, ...	20,623
Remaining in the hospital, 31st December, 1814,	869

The proportion consequently of deaths in the hospital, during the above period, was something more than one in five.

LA CHARITE,

Remaining in the hospital, January, 1804, ...	204
Admitted in ten years, ...	27,456
Total, ...	27,660
Of this number, died in ten years	5,881
Remained, 31st December, 1814, ...	204

Proportional mortality therefore in this hospital, has been about one in seven.

L' HOPITAL DES ENFANS, containing from 600 to 800 patients,

Remaining 1st January, 1804, ...	247
Admitted in the ten years, ...	20,667
Total, ...	20,914
Of these, died	4,688
Remained, 31st December, 1814, ...	420

Proportional mortality therefore is one in four.

HOPITAL ST. LOUIS, capable of containing 1000 patients,

Remaining in January, 1804, ...	495
Admitted in ten years, ...	56,934
Total, ...	57,429
Of these, died in ten years	2,138
Remained, 31st December, 1814, ...	1,129

Proportional mortality therefore only one in twenty-six.

"The

success of an operation, and that the want of it will not be supplied, even by the acknowledged skill of the most judicious and experienced practitioners.

In cases of compound fracture,* the unfortunate individual introduced into a crowded and ill ventilated hospital, may be considered in many instances, as almost surrendered up to inevitable destruction, and the surgeon wanting the healing

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"The inferior proportional mortality of St. Louis's, is accounted for, by the nature of the diseases treated in it, viz: cutaneous eruptions and other chronic ailments—rather from the following, it is also situated on a rising ground, the wards are large, commodious, clean and well ventilated."—*Notes on Hospitals by Dr. Clarke.*

"In our two great city hospitals, St. Thomas's and St. Bartholomew's, about 600 die annually, or one in thirteen of all admitted as in-patients *** indeed, with respect to hospitals in general, *as now constructed and regulated*, I cannot help fearing, that they cause more distempers than they cure, and destroy more lives than they save."—*Price on the expectation of Lives, &c.*

"In 1689, the mortality in St. Thomas's hospital was 1 in 10. —in 1741 it remained the same. In 1783, improvements were made in the cleanliness and ventilation of the hospital. In the ten preceding years, the mortality was 1 in 14. In the ten subsequent ones, it was 1 in 15.6. The average mortality for the next ten years, was 1 in 14.2. From 1803 to 1813, it was 1 in 16.2. The general average from 1764 to 1813, was 1 in 15.

The mortality among the medical patients was above this, the mortality of those under Sir Gilbert Blane, was 1 in 9.8." —*See Sir Gilbert Blane's paper in the 4th vol. of the Medico Chirugical Transactions.*

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* It was a remark of Mr. Howard's, in the account of his visitation of prisons and hospitals, that no case of compound fracture, nor trepan, in the hospital at Leeds, survived, till the ventilation of the wards was improved.

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influence of pure air for his patient, is placed only between a choice of difficulties. If he seeks to preserve the limb, the unhappy patient may fall a victim to inflamation and gangrene: while if amputation is performed, he may sink under the suppuration and hectic which succeed it. In amputations also, it happens, that the complete cure of the stump cannot frequently be accomplished without dismissing patients from the house into a purer atmosphere.*

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* The following extract from Baron Larrey's work on military surgery, affords the most convincing proof that can be offered, of the pernicious effects of placing wounded men, in close unventilated apartments. From it, we learn, that the wounded, when exposed to the inclemency of the weather, and even subjected to violent motion in carriages, recovered, in consequence of being enabled to breathe pure air, while those who had hospital accommodation, and other concomitant comforts, fell victims to the foul air which they respired.

"The battle of Eylau, the most dreadful ever witnessed, furnished us vast numbers of wounded men; I had in the morning of that day, established an ambulance for the imperial guard in the barns, near the entrance of the town; but unfortunately, they had been opened on all sides, and the straw that covered them was taken away for the horses. We were under the necessity of placing our wounded men upon dung-hills covered with snow: and there were several thousands of them, as well of the guards, as of the line, collected together in these unsheltered accommodations. All those severely wounded in the imperial guards, and a great part of those of the whole army were dressed, and their operations performed in the first twelve hours, it was not until then, that we could take a little rest. The next day, at day-break, we resumed our functions with the wounded men of the guards, giving assistance at the same time, to a number of those of the line, and to the Russian prisoners. I was particularly occupied too, about the removal of our wounded. I first caused all the severe wounds, such as had suffered amputation of the thigh or leg, or had received dangerous wounds of the breast, and several for whom I had applied the trepan, to be removed into a large house in the town of Eylau.

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Those labouring under the venereal disease, as well from the nature of the disorder, as from the operation

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The impossibility of all the wounded, both of our own, and of the enemy, being contained in this small town, already crowded with troops, the danger of an epidemic breaking out amongst them, the extreme penury in which we were, in the midst of plains covered with snow, abandoned by their inhabitants, and destitute of all resources, were so many motives which imperiously demanded the evacuatien of the wounded. The Emperor had foreseen all these circumstances, and was persuaded, *that it was better to expose the wounded to the vicissitudes of a long, difficult, and at all times painful removal, than to see them dying from causes, which it would not be possible to remedy.* An order was given for their general evacuation, and I effected the removal of all the serious wounds of the guards, in the first twenty-four hours. They were removed from Eylau to Inowracklaw, a distance of 165 miles, through the worst of roads, over ice and snow, and across the floods of the brooks, swelling from the recent thaw.

I shall endeavour to point out the advantages to be derived from the speedy removal of the wounded after a battle, when they cannot be taken care of in the neighbourhood of the field, during the first period of the wound, with that security and attention to health, which their situation demands. In giving my opinion on this subject, I am supported by experience, and his Majesty, without doubt, in ordering this measure, called to mind, the success we had obtained in the evacuation of the wounded, from the siege of St. Jean D'Acre in Egypt. In fact, no one can doubt of the serious inconvenience which must result from the state of rest in which the wounded remain, when collected in too great numbers in an hospital after an action. Adynamic affections, the hospital gangrene, proceeding from the copious discharge from the wounds and other animal excretions, &c. all these causes impart even to simple wounds, and still more to severe ones, a serious character, and their termination is too often fatal. In what a different situation, on the contrary, do those patients find themselves, who have been removed to different points, a short time after the battle, the secretions are kept up, the suppuration takes place in just proportions, the sloughs are readily detached, by the increased oscillation of the subjacent vessels; the wounds become cleansed; their edges

operation of mercury, taint the surrounding atmosphere to a remarkable degree, and venereal

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edges unfold, and approximate themselves, by the gradual expansion of the vessels, and by virtue of this general excitement, they inosculate amongst themselves, or contract adhesion by means of the slight inflamatory swelling that supervenes —The external air, always more pure than that of inhabited and close places, gives activity to the secretions, the cuteneous transpiration, more especially, is continually carried off by the free current of air, and the patients have no reason to fear its repecurssion.

In the retreat from Syria, notwithstanding all our disadvantages, we only lost a fifteenth of the wounded. In Poland, in spite of the severity of the cold, and the difficulty of our roads, in spite of the insufficiency and imperfection of our means of transport, for we were obliged to add to our own carriages with springs, sledges, and vile waggons, the movements of which were rendered still more violent by reason of the thaw and frost, which followed each other successively : in fine, notwithstanding the penury of provisions, and the fatigue of every description attendant on so long a route, my wounded men, in the general way, arrived in good condition at Inouracklaw, where their cure was prompt and complete; we scarcely lost the eleventh part of them, and there were nevertheless a tolerable number of very severe wounds amongst them, as well by their own nature, as by the accidents with which they were complicated ; such were certain wounds of the breast and amputation of the thigh, with the hospital fever, *which had already begun to shew itself in the hospital at Eylau.*

" It is very probable, that those unfortunate patients, had they remained in that town, would have died of this complication, which would without doubt, have become epidemic, as at Brün. I remember myself, placing several wounded men on the carriages, who were scarcely able to turn in their beds, and whom we expected to see expire within four and twenty hours, who nevertheless, arrived at their destination free from fever, and the wounds cleaned and in good condition. So happy a result ought fully to justify such a measure in the minds of those persons who regarded this evacuation as an act of barbarity, &c."—*Larry's Memoirs of Military Surgery.*

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real ulcers, in the malignant and fatal character which they so constantly assume in hospitals, evince

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" The most superficial peruser of surgical works, will point out the differences of opinion which exist as to the propriety of operation, between those who have practised among robust peasants, and in the smaller establishments, and those whose patients have been taken from among artizans and inhabitants of large towns and cities, or treated in large, confined and ill aired hospitals. The military surgeon anticipates all the consequences of delayed operation, not only from the particular effects it may have on individuals, but the great influence which protracted suppurations, hæmorrages, diarrhæas, febrile exacerbations and hectic sweatings, must have upon those who live within an atmosphere constantly impregnated with the effluvia of patients suffering under them.** The grand source of safety to the individual operated on, is removal to a distant and separate ward, and if possible, to another hospital. To those who have not had experience on this point, it may appear a very useless, if not a very injurious measure, thus to remove the stump patients; but I hold it as one of the best established facts in military surgery, that a cautious and well regulated shifting of those cases from the hospital, or, if possible, from the town, in which they have been established, is one of the most certain means of ensuring their ultimate recovery. I have witnessed hundreds of cases in confirmation of this; I have seen the men, who, on the first day of a transfer from one hospital to another, have been obliged to be assisted into the boats or waggons, or held on mules, enjoy a sound night's repose, awake with a craving appetite, have a copious and natural alvine discharge, and proceed on rapidly towards a convalescence or a cure, *which has only been interrupted by their arrival at an hospital station.*

When I reflect on the other hand, on the poor sallow dejected beings, that have pined in the hospitals: the flabby non-adhering inanimate stumps, lined with a discoloured half digested sanies, which have disappointed my most sanguine hopes—I SHUDDER AT THE CONTRAST."—*Observations on Military Surgery by John Hennen, Deputy Inspector of Hospitals.*

" After a great battle, the wounded are usually collected in large hospitals. If these hospitals are not greatly thinned at

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the injurious consequences of their defective ventilation.

From these and a variety of other facts and reasonings that might be adduced, we shall feel no difficulty in drawing the just conclusion with respect to the impurity of the air of hospitals, and we may without hesitation admit, that the sick, pent up amidst the morbid effluvia from their own bodies, as well as from those of other patients, must necessarily be placed in situations the most unfavourable for their restoration to health, and that the ill success attending hospital operations, the more extensive suppurations, the more abundant and ill conditioned discharges from their ulcers, the cough and hectic under which the sick so frequently sink; as well as the erisypelatous inflamation * and other diseases

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the end of three or four weeks, no wounds do well, and the health of most of the men is affected by the air of the hospital, a fact that is constantly demonstrated by the amendment of those who are able to travel to a new station or establishment. Amputations performed in an hospital of this kind seldom do well, the febrile irritation remains after the operation, the wound suppurates, does not unite, the strength gradually decays, and the patient dies exhausted. The whole of this statement was exemplified in a very striking manner, in our hospitals, after the battle of Vittoria, properly so named: and a second time after the battle of the Pyrenees, near Pampeluna, where the same hospitals were necessarily a second time filled with the wounded, many of whom required the greater operations of amputation. If there be any disease endemic in the country at the season of the year, or time, a soldier undergoes a secondary operation *** *or when contagious fever is prevalent, as in the greater part of our hospitals, after the retreat from Burgos;* he will frequently sink under the united pressure of the disease and the operation."—*Guthrie, on gun-shot wounds.*

* "In the impure air of hospitals, and in all places where the air is impregnated with carbonic acid and other noxious gases, we find that various affections decidedly inflamatory, especially

diseases which so uniformly pervade these places, are all attributable to their contaminated atmospheres, caused alike by their over-crowded state, and their defective ventilation.

Of the many diseases which supervene on wounds and operations, in close air, the most formidable and fatal is that peculiar species of mortification, which from its appearance only, where crowds of sick are assembled together, has received the appellation of Hospital Gangrene.

This disease from the frequency of its appearance, and the mortality of its progress, has in a particular manner, attracted the attention of surgeons, within these late years. So destructive has

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pecially those which are attendant on wounds, affect the body and the sanguiferous system in particular, in a very different manner from what is observed when the patients are living in a more salubrious air. All inflamations assume a character more or less unfavourable, in consequence of the influence of bad air.—*This is particularly striking in cases of erisypelas.* In such instances, living in an impure atmosphere has a singular effect in augmenting the sense of weakness and dejection, which patients always experience in a certain degree, and in these cases, it may even go so far as to produce a total alteration of the state of the pulse. But if the attention be paid to the disease in a situation where the atmosphere is not impregnated with putrid effluvia, it will be found to put on a very different shape.—The symptoms of dejection of nervous irritation, and of cerebral disturbance, are much less conspicuous, and the state of the pulse, especially in patients who have not been previously debilitated by other diseases, bears a great resemblance to that which takes place in inflamation of the chest."—*Cooper's Surgical Dictionary.*

I have scarcely ever visited a large and crowded hospital, without being assured, that numbers are constantly destroyed by this disease supervening on wounds and surgical operations, and in all instances, I have heard its appearance attributed to the impure air of the hospital.

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it been, that it may justly be considered as the great scourge of naval, military, and of all close and crowded hospitals. The French surgeons have afforded us the earliest details of this malady. The first accurate description of it in English was published in the London Medical Journal, for 1785, by Mr. Gillespie, surgeon to the Royal Navy, who declares it to be one of the most troublesome and dangerous diseases, which afflicted the British seamen. Mr. Dowell has given an accurate account of its alarming progress, and of its highly infectious nature among the men on board the Prince of Wales.

Sir Gilbert Blane and Dr. Trotter in their works on the diseases of seamen, give it the appellation of malignant ulcer, and afford a very ample detail of its symptoms and ravages :—Dr. Rollo has recorded its devastations in the artillery hospital at Woolwich.

John Bell has made hospital gangrene the subject of particular remark. * Professor Thompson has

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* "The HOSPITAL SORE I do not regard as a mere ulcer, to be treated like other common ulcers, but as a general affection of the system, a mortal disease; for when it rages in a great hospital it *is like a plague,* few who are seized with it can escape.

"There is no hospital however small or airy, or well regulated, where this epidemic ulcer is not to be found at times; and then no operation dare be performed! every cure stands still! every wound becomes a sore, and every sore is apt to turn into a gangrene; but in great hospitals especially, it prevails at all times, and is a real gangrene; it has been named the hospital gangrene, and such were its ravages in the Hotel Dieu of Paris, (that great store-house of corruption and disease,) that the surgeons did not dare to call it by its true name; they called it the rotteness, foulness! sloughing of the sore!—the word hospital gangrene they durst not pronounce! for it sounded like a death bell, at the hearing of that ominous word, the patients gave themselves up for lost.

La Motte

has written us a very circumstantial history of it in

La Motte says, "Mortification ce qu'on appelle POURITURE, a L'Hotel Dieu de Paris, laquelle survient et accompagne presque toutes les playes qui sont traitte dans cette, hospital," and the disease was not named "dans le crainte d'inquiter ces blessez qui croiroient etre perdue des que l'on appelleroit cet pouriture GANGRENE."

In the Hotel Dieu, this gangrene raged without interruption for two hundred years, till of late. under the new government of France, the hospital has been reformed," *(the disease is however yet very frequent in it,)* "A young surgeon says an ancient French author, who is bred in the Hotel Dieu, may learn the various forms of incisions and operations too, and the manner of dressing wounds; but the way of curing wounds he cannot learn. Every patient he takes in hand, (do what he will) must die of gangrene, * * * * "There are various ways in which the excitability of an inflamed part may be exhausted, so that it shall fall into ulcer or gangrene; ** but this infection of the hospital is the most irresistible of all. The moment that a man is struck with it you may observe him become pale, sallow, languid, low-spirited, with a heavy eye, a confused head, a loathing of food, a fretful pulse, and in short, a universal disorder, which he can neither account for or desscribe." **** From all I could ever observe, the vulgar expression of the tainted air of an hospital, is not incorrect.—This ulcer and gangrene is in an hospital of wounded men, *what PUERPERAL Fever is in a lying-in ward*, it is an infection to which all is equally exposed. *** What then is a surgeon to do?—Is he to try experiments with ointments and plasters, while men are dying around him?—Is he to seek for washes and dressings to cure such a disease as this?—Is he to expend butts of wine, contending as it were against the elements?—No! let him bear this always in mind, that no dressings have ever been found to stop this ulcer; that no quantities of wine or bark, which a man can bear, have ever retarded this gangrene; let him bear in mind, *that this is an hospital disease;* that without the circle of the infected walls the men are safe, let him therefore hurry them out of this house of death; let him change the ward, let him take possession of some empty house, and carry his patient into good air; let him lay them in a school room, a church, on a dunghill, or in a stable, (like Paree's gangrened soldier) let him carry them any where but to their graves."—*John Bell's principles of surgery, Vol. 1, P. 107.*

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his lectures on inflamation. The devastation which this disease has made in our hospitals abroad, has afforded military surgeons such opportunities of observing it; that we have from them a very detailed description of its symptoms, and of the havoc which it makes among our troops.*

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* The following description of this disease, as it appeared in the hospital of Bilbao, is taken from a medical writer of evident judgment and sagacity, and whose duties afforded him ample means of observation.

" Let us suppose our wounded have all been going on well for several days, when suddenly one of our promising patients complains of severe pains in his head and eyes, a more particular tightness about the forehead, want of sleep, and loss of appetite, and that those feelings are accompanied with quickness of pulse, and other symptoms of fever: his wound, which had been healthy and granulating, at once becomes tumid, dry and painful, losing its florid colour, and assuming a dry and glossy coat.***If this incipient stage was overlooked, the febrile symptoms very soon became aggravated: the skin around the sore assumed a highly florid colour, which shortly became darker, then bluish, and at last black, with a disposition to vesicate, while the rest of the limb betrayed a tendency to œdema.

All these threatening appearances occurred within twenty-four hours; and at this period also, the wound, particularly if it was situated on a muscular part of the thigh, buttock, or calf of the leg, *whatever might have been its original shape, soon assumed the circular form.* The sore, now acquired hard, prominent, ragged edges, giving it a cup like appearance, with particular points of the lip, of a yellow dirty hue, whilst the bottom of the cavity was lined with a flabby blackish slough.

This rapid progress, and the circular form of the ulcer, were highly characteristic of hospital gangrene, and obtained almost universally in every wound infected with it, wherever situated. I have seen the external ear in this manner destroyed, as if in a series of concentric circles, and the same occur during the destruction of the palpebræ. Even upon surfaces barely contiguous, as the finger and toes, it generally spread in a similar manner; *so that the sore which might have been on the*

From this disease appearing exclusively in close and crowded hospitals, it is very justly attributed

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the middle finger or toe, and confined entirely to it at the morning's dressing, by night, engaged the adjoining sound ones, and in less than twelve hours more, embraced the whole foot or hand. The originally affected spot, was always the centre of this wide spreading diseased circle.***The discharge in this second stage became dark coloured and fetid, and the pain was extremely poignant.—The gangrene still advancing, fresh sloughs were rapidly formed, the increasing cup like cavity was filled up and overtopped by them, and the erisypelatous livor and vesication of the surrounding skin gained ground, while chains of inflamed lymphatics could be traced, from the sores to the adjoining glands, there exciting inflamation and suppuration, which often furnished a new nidus for gangrene. The face of the sufferer assumed a gashly anxious appearance ; his eyes became haggard, and deeply tinged with bile, his tongue loaded with a brown or blackish fur, his appetite entirely failed him, and his pulse was considerably sunk in strength, and proportionally accelerated. In this stage, the weakness and irritability of the patient were such, that the slightest change of posture, or the most delicate examination of the sore, put him to torture, increased by his inability to steady the limb, which, if moved at all from the bed, was seized with tremors aad spasmodic twitches.*** When these nervous affections came on, the bravest soldier betrayed a symptom, which in those of less strength of mind, formed a striking feature in every stage of the disorder, viz. the greatest imaginable impatience of pain and depression of spirits. Men who had born amputation without a groan, shrunk at the washing of their sores, and shuddered at the sight of a dead comrade, or even on hearing the report of his death, instantly predicting his own dissolution, and sinking into sullen despair.***The third and last stage was now fast approaching. The surface of the sore, was constantly covered with a bloody oozing, and on lifting up the edge of the flabby slough, the probe was tinged with dark coloured grumous blood, with which also its track became immediately filled : repeated and copious venous bleedings now came on, which rather sunk the patient; the sloughs, whether falling off spontaneously, or detached by art, were quickly succeeded by others, and discovered on their removal, small thickly studded specks of arterial

to the impure air which the patients breathe.—An infected atmosphere, as it is observed by Boyer

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rial blood. At length an artery sprung, which in the attempt to secure it, most probably burst under the ligature; the tourniquet or other pressure was now applied in vain; for while it checked the bleeding, it accelerated the death of the limb, which became frightfully swelled and horribly fetid. Incessant retchings soon came on, and with coma, involuntary stools, and hiccough closed the scene. Often, however, the patient survived the acute state of the disease, and sunk under severe irritation, absorption of putrid matter, and extensive loss of substance, without any other symptoms, than those of hectic fever, arising from other sources.

While the acute symptoms, as above described, were proceeding in one part of the hospital, the same appearance began to spread through another, at a distance; for immediate contact, though highly dangerous, was by no means necessary, towards the propagation of this most insiduous disease. The stumps which had been nearly healed, caught the morbid disposition; those whose healing by the first intention, was reasonably to be looked for, opened, retorted their edges, put on an erisypelatous appearance, and at last, bursting up altogether, presented a frightful cup-like excavation, edged with the true characteristic *circular lip*. The slightest scratch of the dissecting knife, festered; ulcers, whether simple, or constitutional, became gangrenous; wounds long healed, broke up, and fell into a state of foul suppuration; nay, the skin, although perfectly sound, which had been touched with a sponge employed in washing the gangrenous sores, ulcerated, and soon became itself a slough. This was often observable among the *orderlies and nurses*.***Such were the symptoms, which characterised the hospital gangrene at Bilboa; one of the most subtle and destructive poisons, that ever infected an hospital, attacking equally the most robust, and the most debilitated."

"My fears were soon verified at Cordeleria, for in a few days, the whole hospital was overun with gangrene, which I more particularly dated from the arrival of some fresh wounded men from Vittoria, of whom, about thirty were in an advanced stage of the disease, which, it was said, first appeared upon the journey down. *The ward appropriated to sloughing ulcers*

Boyer, may produce, in the most simple wound, unfavourable changes, partly by its immediate action on the surface of the wound, but principally by its hurtful influence on the whole animal

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ulcers, at once became a horrid scene ; every sore in the house assumed a malignant character ; and the deaths increased in nearly a three-fold proportion."

"In an hospital in the neighbourhood of Brussels, situated at about two miles from the city, on a swampy flat, covered with trees, through which the great Antwerp canal was cut, and the Doyle and several tributary branches crept along, the Brunswickers had their hospital establishment. *Their wounded lay on the floor and were much crowded.* Gangrene raged there, it frequently seized a stump, three hours after amputation, and when I visited that hospital 28 days after the battle, one solitary survivor alone marked the performance of a successful amputation. *** The practical conclusion I would draw from all I have heard or seen of this formidable disease, is **** that it is a duty of the most urgent kind at once to break up an establishment where any suspicious sores may occur" The same author, in another part of his work, says, " I had the building separated into wards and divisions, opened ventilators, removed nuisances both within and without, and enforced the most rigid attention to personal cleanliness, and to the frequent renewing and airing of the bedding. I had the most striking instance within my own experience, of what attention to these points can effect in the way of prevention ; for at the general hospital at Elvas, of which I was principal medical officer during the whole period of the successful operations before Badajos, in 1812. Although 2500 wounded were treated there, yet not a single instance, either of hospital gangrene or typhus fever appeared among them, although both these diseases *had raged with unexampled fury the two preceding years.* This happy result, I attributed to cleanliness and ventilation."—*Observations on military surgery, by John Hennen, deputy inspector of military hospitals.*

" When the allies a twelve month ago, (1814) were near Paris, the number of patients in L'Hotel Dieu, was double what it is at present, and *hospital gangrene*, was frequent.—

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mal œconomy. This disease may also be considered as contagious, when once it is introduced into a crowded hospital, all the wounds and ulcers immediately assume a gangrenous character. M.

The beds are still too numerous, and carefulness in ventilating the wards, and strict attention to cleanliness, do not entirely prevent the occurrence of this dreadful disease."—— *Sketches of the medical schools of Paris, by John Cross, p.* 83.

"The surface of the wounds, and sores in the hospitals" (at Antwerp,) "had a less healthy appearance than those of the men we had left at Brussels. They manifested a tendency to sloughing, and had evidently passed or were passing into that state which is well known to medical men, by the name of hospital gangrene."

"The hospital gangrene, which during our first visit to Antwerp, was confined to the two extremities of the hospital, had now spread to the middle divisions."——*Observations on the British Military Hospitals in Belgium, after the battle of Waterloo, by John Thompson, M. D.*

"During the late war in the Peninsula, and notwithstanding the indefatigable exertions of the Inspector General of Hospitals, seconded by unremitting attention on the part of the medical officers in general, to every thing that had a tendency to promote the comfort, and restore the health of the sick and wounded, opportunities for observing this disease, unfortunately were not wanting. I have learned from good authority, that few, if any, of the large hospital stations, were, at one time or other, entirely exempted from it, *(phagedæna gangrænosa)* and that in some of them, its ravages were very extensive. It is obvious, however, that this ought not to be matter of surprise—for there are many reasons for believing, that it is altogether impossible to prevent the occurrence of this disease, and when once introduced into a surgical hospital, many circumstances combine to render it extremely difficult, if not impossible, to prevent its being more or less disseminated."—P. 5.—1818.—*Blackadder's observations on Phagadæna Gangrænosa.*

The long and extensive wars in which France has been engaged, since the era of the revolution, have afforded the surgeons of that country, ample opportunities of witnessing this formidable

M. Vigaroux says it prevailed for 20 months in two hospitals, at Montpellier, and he states, that it often invaded the slightest scratches. Even those

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formidable disease. In seeking to investigate its origin, we find their theories involved in the obscurity of the remote causes of all contagious and infectious diseases. But, amidst their contradictory theories, they all concur in tracing it to the corrupted and tainted atmosphere of the hospital, which is alike the field for its production and diffusion.—M. Pouteau, in his posthumous works, published in 1783, has two valuable memoirs, on what he terms 'La Gangrene humide des hopitaux,' and gives as his opinion, that it essentially owes its origin 'au mauvais air qu'on respire dans les grands hopitaux,' and so dreadful has been the progress of this disease, as generally observed in the French hospitals, that he proposes the following question, p. 131. 'Les Hopitaux seroient ils donc plus pernicieux qu'utiles a l'humanite?'

In 1796, Citizens Moreau and Burdin, read to the 'Societè de Santè de Paris,' an 'Essai sur la gangrène humide des hôpitaux,' with regard to its cause, they observe, p. 5, 'La Gangrène humide—commes les dysenteries et la fievre d'hôpital et de prison, sont productes par l'action des miasmes putrides dont l'air est surcharge.'

M. Delpech, professor in the medical schools of Montpellier, presented a 'memoir sur la complication des plaies et des ulceres connue sou le nom de pourriture d'hôpital' to the Royal Institute of France. In this memoir which was published in 1815, we have a very minute and excellent description given of the symptoms of hospital gangrene. He refers the production of this disease and of typhus, to the same causes, the debilitated state of the patients, and the corrupted condition of the atmosphere of the hospitals. After giving a lively picture of the wretched condition of the French armies, after the reverse they sustained, he observes, 'Un tel ensemble de causes debilitantes, toutes de plus efficaces, etait bien propre á donner aux humeurs un caractere septique.'—'Aussi les fièvres nerveuses devinrent-elles tres-communes'—'Les emanations septique dont L'atmosphere des hôpitaux se trouva bientot surchargee, ne tarda pas à donner aux maladies qu'on y observait la forme du typhus noscomial.'—'Alors aussi en vit paraitre et regner epidèmiquement la pourriture d'hôpital, qui s'emparait indistinctement de toutes le blessures."

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who breathe the purest air, may be infected, by putting in contact, with a wound or ulcer, sponges or lint, impregnated with the infection of this peculiar disorder; but it is in hospitals* that its contagious nature is most evident, because it is in the foul air of these places that the constitution is broken down, and prepared for its reception.

When the cause of this formidable disease is so evidently manifested, it must appear surprising, that it should be allowed to subsist, more particularly as every writer on the subject has enforced the necessity of ventilation. "The means of preventing and of exterminating the malady, (says Dr. Thompson,) resolve themselves into a few particulars. The first of these means is a free ventilation of air."

Dr. Hales, whose mechanical mode of ventilation, was at one period very generally adopted, makes the following observations on the effects of ventilation, in arresting this formidable malady—"The surgeons observe, that since St. George's Hospital was ventilated, they are not subject as before, to spreading ulcers, these spreading sores are peculiar to ill aired places; so that when they occur in hospitals, they are often obliged to send back patients into the country, where they often got well by their own dressing, of such ulcers as in the hospital used to defeat all the art of the surgeons. And doubtless in most other distem-

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* "It is also highly contagious; and I am informed, by Mr. Earle, that the diffusion of this malady, *when committing unusual ravages in the foul wards of St. Bartholemew's hospital*, was traced to an inadvertant use of the same sponges for different patients."—*Welbank on Sloughing Phagedœna Medico Chirurgical Transactions, vol. 11th.*

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pers, the sick will fare the better for having fresh instead of foul putrid air."

Though the injurious impression of the impure air of hospitals, is most strikingly evinced in compound fractures, ulcers, wounds of the head, and in all cases where the cuticle is abraded, still we may also evidently trace its injurious impression on those diseases which may be termed constitutional, which are independant of any external injury, and the treatment of which comes more directly within the province of the physician. We may witness in many hospitals, a slow, depressing and wasting fever, creeping over the patient's other complaints, becoming in the end the principal disease, and resisting the exhibition of every remedy, till dismission from the building itself ultimately effects the cure.

Those who have been themselves confined by illness in their chambers, and who have subsequently, when convalescent, been enabled to breathe the pure air from an open window, and have felt this grateful fluid play on their parched and feverish skin, will require no argument to convince them how much the recovery of the sick is retarded by the foul air which they breathe in hospitals, and how rapidly their convalescence would be accelerated by that degree of ventilation which would dissipate their morbid steams, prevent the accumulation of their infectious effluvia, and afford to the parched lungs of the sick the grateful and salutary draught of a pure and wholesome atmosphere.* No hospital can be considered

* By the analysis of the air in the wards of hospitals, M. Brugmans has clearly ascertained that there exists in it a peculiar animal matter, highly disposed to putrefaction, that oxygen gas is considerably diminished, and azote and carbonic gas

ed well ventilated where the wards evince any disagreeable warmth or smell, nor can that atmosphere be conducive to health which conveys to our lungs the putrid emanations of others. The inbred diseases of hospitals produced by the respiration of animal effluvia, will in some measure seize on every individual who habitually resides in them. So essential is a pure atmosphere, and so much depends on its influence, not alone on the patients in hospitals, but on those whose avocations lead them to live in, or even to frequent them.

Acordingly we find, that all infectious diseases become more easily communicated in confined places. Ophthalmia* spreads rapidly in work-houses, barracks,

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gas augmented; and that by the tests of nitrate of silver, acetate of lead, and oxygenated muriatic acid gas, the presence of sulphuretted hydrogen gas is detected. See his most interesting paper, "De l'Etat et de la composition de l'Atmosphere," Annales de Litterature, &c. vol. xix.

Glass globes filled with ice, have been hung up in hospitals, and the substance condensed on the sides, has been found to consist of animal matter.—Candles burn dimly near to the floors of ill ventilated hospitals, the same event happens in close and crowded rooms, and the dizziness, disposition to faint and the languor experienced in them, proceed perhaps from the carbonic acid gas, which they contain.

Dr. Hales ascertained by various experiments, that a candle burned with more rapidity in the ward of an hospital, after it had been ventilated, than when its combustion took place in the same ward before its ventilation.

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* "The history of all diseases originating from some particular impression received from the atmosphere, but capable when formed of propagating themselves by contagion, such as influenza, scarletina, hooping cough! is rendered particularly difficult: for the same circumstances which form the communication by contagion, produce also a predisposition to be acted upon by the more general cause existing in the atmosphere.—

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barracks, and hospitals. Even the influenza, which from the rapidity of its progress, appears to be produced by some general atmospheric impression, becomes contagious, and more virulent in schools and hospitals. We are informed by Sir Gilbert Blane,

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The principal cause which gives force and opportunity to the action of contagion, is the crowding individuals together, in too limited spaces. The several diseases above mentioned, and which are mostly those of infancy, are always most general in their attacks, and also most severe in their symptoms, in hospitals and public seminaries, where sufficient attention is seldom paid to the separation of individuals, into distant apartments. When *Ophthalmia* is epidemic, it is always first met with, and remains longest in such situations—a circumstance however perfectly explicable on the greater field given, to the operation of the infectious discharge from the eyes of the affected, upon those of the healthy.——The appearance of ophthalmia among the crews of ships, and in barracks, was often met with long before the introduction of the late destructive and virulent disease. *In the army, such an ophthalmia has extended to whole regiments, without any appearance of the disease among the inhabitants of the neighbourhood;* while the free intercourse which subsists among the men, as to washing in the same water, using the same towels, and sleeping more than one in a bed, readily accounts for the rapid extension of the disease in the same corps, *yet the excessive crowding together of men, will often of itself, engender inflamation of the conjunctiva,* and to an eye predisposed to inflamation, nothing is more prejudicial than remaining long in a crowded situation. By the excessive crowding of soldiers in barracks, they are subjected to a vicissitude of temperature, equal to the difference between the day and night of warm climates, while the exhalation from the lungs, produces a plentiful supply of moisture.—Whether, therefore, the cause of ophthalmia, exists in some spontaneous change in the state of the atmosphere, or, in the immediate effect of its vitiation, by over crowding individuals together; this conclusion is certain: That from a number of people so crowded, especially in their dormitories, the constitution is rendered more disposed to be acted upon by the exciting causes, whether natural or thus engendered.**

that the mumps *(cynanche parotidea)* frequently spreads in ships of war, and there is scarcely any infectious disease that is not more readily communicated in hospitals, these over-crowded and ill ventilated abodes of human suffering.

Children frequently fall victims to a slow suffocation from breathing the vitiated air of our Foundling and Lying-in Hospitals, and this, to an extent, that would be scarcely credible to the generality of readers.

The visitations of *puerperal fever*, more particularly in the hospitals of Paris, London, and Dublin, have been so frequent and so fatal, as to have forced itself on the attention of all, and even to excite doubts in the minds of many, whether these institutions, so benevolent in their design, have not under existing circumstances, frequently counteracted the object for which they were originally erected. No one can question the amiable spirit which led to the provision of these receptacles for poor women, at a period when they most stand in need of comfort and assistance, but when

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At present, I speak only of the disease, as produced in individuals, otherwise healthy; the crowding of sick together, produces more violent and specific forms of disease, of which the conjunctiva is also the occasional seat.***——*A practical treatise on diseases of the eye, by John Vetch, M. D. published* 1820.

Ophthalmia is a disease of frequent occurrence in workhouses; in some, it might be almost considered endemic. Mr. Hardman, the indefatigable and zealous governor of the Liverpool house of industry, has informed me, that this disease has nearly disappeared from among the children of that institution, since the ventilation of their dormitories—before this time, it was a constant attendant on them.

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we consider the prevalence of this formidable disease in these hospitals, and the numbers who fall before it, we are almost warranted in questioning the amount of their actual benefit, and are led to think, that the money expended in their erection and support, would have been more beneficially applied by procuring their usual inmates the necessary attendance and comforts at their own dwellings: for though, from the wretched accommodation of many at their houses, the sum of these comforts would be reduced, still the amount of their actual mortality would be, perhaps, also diminished.

Among the many causes to which puerperal fever is attributed, we may perhaps, assign to impure air the first place. Lying-in Hospitals in an eminent degree call for every attention to cleanliness and ventilation. Hospital pestilence is peculiarly dangerous to lying-in women, and the more frequent recurrence and greater fatality of this disease in hospitals than in private practice, warrants us in referring its generation in some measure to a specific contagion, generated in crowded and confined apartments.—Were these hospitals *properly* ventilated, and the accumulation and fermentation of animal effluvia thereby prevented; no doubt the mortality which now occasionally pervades them, would be, to a considerable extent prevented, and their amiable founders and patronesses would have the pleasure of seeing them impart all the benefits which their humanity led them to expect from their establishment and support. *

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* In considering the ventilation which is at present adopted in these establishments, and it will be found, that it is only *occasional* in its action, and that it subjects the poor women to partial

That dreadful distemper, scarcely less malignant than the plague itself, known by the appellation of gaol or hospital fever, has long been known as the inbred pestilence of hospitals; and has contributed more to thin our fleets and armies than all the other effects of warfare.—Sir John Pringle, constantly expresses his dread of this formidable malady, and his disapprobation of crowding the sick in large general hospitals, who under these circumstances, invariably succeed in producing it; and as the most respectable physicians all

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partial currents of cold air, under circumstances, where they are least able to resist its injurious impression. It may even be questioned, whether, during the prevalence of cold weather, it would be safe, adequately to ventilate a lying-in hospital.

Under these circumstances, provision should be made to ventilate by warm air, not however as it is now usually done, by sending in small quantities of a burnt and overheated atmosphere, but in making such arrangements as would secure a full and unintermitting stream of this fluid, at a moderate temperature.

Tenon, in the preface to his work on hospitals, states, that the mortality of lying-in women in the Hotel Dieu, in the year 1780, amounted to one in fifteen, which he attributes to the ill ventilated state of the hospital. The mortality of the children in the same place is, as he informs us, one third of the entire. In other hospitals, better ventilated, the mortality of women, does not exceed one in one hundred, and that of children, one in twenty-four. He also says, that one in fifteen of the children in the Hotel Dieu are still-born; all this he attributes to the bad air of the hospital.—Sir Gilbert Blane says "the like remark," (viz. recoveries in all classes of patients are retarded by impure air) may be made, in regard to lying-in women and infants. If pure air is necessary to preserve the health of the most hale and robust. how much more must it be so, when the powers of nature are weak, or under severe trials? In short, without pure air, the purposes of such institutions would be entirely frustrated. The utmost professional skill, and the most appropriate means of relief, would be unavailing."—*Medico-chirurgical transactions, vol.* iv.

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concur, in bearing testimony to the fact, that typhus, is an almost invariable attendant of crowded hospitals, it becomes of importance to ascertain the utility of those establishments which are expressly erected for the reception of this disease, or in other words, to investigate the œconomy of what are called FEVER HOSPITALS.

We are indebted to Dr. Haygarth, for the establishment of these institutions: his inquiries led to ascertain, that contagion of all kinds is most active in close and ill ventilated places, that when adequately diluted with fresh air, it becomes nearly inert or harmless. He also contributed to dissipate many groundless apprehensions with respect to the extent of the influence of contagious poison, proved that its sphere of activity is confined to within a very short distance of the person labouring under disease, and that there is no reason to suppose, that the general atmosphere is ever infected with the seeds of febrile contagion.

Following up these views, with a view to practical advantage; he succeeded in 1784, in converting some wards of the Chester Infirmary into *fever wards,* which led to the adoption of a similar measure in Liverpool, under the direction of Dr. Currie. These experiments were found so satisfactory, and so fully established the inertness of febrile contagion, when properly diluted with fresh air, that public attention was called to this means of preventing its diffusion. Dr. Ferrier, in 1796, during the prevalence of a highly malignant and contagious fever in Manchester, succeded in obtaining there a *separate* establishment for the reception of fever. This example was followed in many large towns in England and Ireland, as Leeds, Cork, Waterford and Dublin. In 1801, when a very malignant fever prevailed in London, " The institution for the cure and prevention of

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contagious fever in the metropolis," was proposed and similar establishments have since become more generally adopted.

The benefits of fever hospitals, may be enumerated in a few words.—In the confined and filthy habitation of the poor, when one person of a family is infected, the disease constantly seizes on every individual of the house, from thence it spreads into the surrounding neighbourhood, those who partially recover are liable to relapses from the same cause that originally produced the disease, and one wretched scene of poverty, disease, and death is the invariable and melancholy result. The febrile contagion is also deposited on the walls and furniture of the close and crowded habitations of the poor, serving as a perpetual source of new infection. The servants of the higher classes of life, in occasional visits to their relatives and friends, imbibe, retain, and disseminate the contagion, till in this manner it assumes the character of a general pestilence, and emanating from one point, acquiring maturity and fecundity in its progress; it scatters its poisonous seeds through every class and gradation of the social scale.——The benefits of fever institutions, therefore, consist in withdrawing the sick poor from their confined habitations, alike destitute of the necessary comforts and attention, and by removing them into the spacious wards of a well ventilated building, and affording them medicine and attendance, an amendment is at once produced in the state of their disease. They run less risk from relapse from the repeated reaction of the contagion, and their convalescence and recovery seem to be wonderfully promoted, even by the mere removal from the confined air of their own dirty houses, to the clean and open wards of an hospital. The diffusion of the disease is, by this method, also prevented,

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the other members of the family escape the infection, and the house of sick are also whitewashed, cleansed, and purified, so that the seeds of the pestilence are thereby destroyed in their birth.—No one who has witnessed the operation of these institutions, can question the benefits which they have conferred, nor can it be reasonably doubted, but that they have in many instances, arrested the formidable ravages of febrile infection. * Among the important benefits derived from these establishments, it would be unfair not to advert to the opportunites which they afford to the physician for varied observation, and to the improvements which have consequently followed in the pathology and treatment of febrile diseases, and a variety of treaties on fever, have lately issued from the press, exhibiting a series of well arranged facts, and legitimate deductions worthy of this, the most enlighted period of medical science.

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* "It has been ascertained, on the most moderate computation, that the removal of every patient in fever, prevents the infection of five others, and that in the apartments of the poor, on an average 1 in 8 of those infected dies of the disease, and that of the deaths, a very large proportion is of adults. On this principle, let us inquire, what may have been the preventive effect of this institution since its establishment. It has received within its walls, 3263 patients, and therefore saved from infection 16,315 persons, among whom, in their own habitations, 2039 would have fallen victims to the disease. Now, without making any addition to this number, for the decrease of mortality among those who have been admitted into the house, and acknowledging, that the observations on which this calculation is founded, afford but approximations to the truth; still it is, perhaps, quite as probable, that these numbers have been under-rated, as over-estimated; and it would be difficult not to admit, that above 2000 lives, mostly of adults, have been saved to the community, by this institution, since its first establishment in 1802."—18*th Annual Report of the institution for the cure and prevention of contagious fever in the metropolis*, 1820.

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When therefore, we consider the important benefits which have resulted from these establishments, and review the reasoning which has led to their adoption, we must be surprised, that this method of preventing the diffusion of fever should have been so lately adopted.

It evinces in the strongest manner, the slow progress of the human mind, and how few rightly generalize facts, so as to direct them to a useful object, even in measures so essential as the preservation of health. *The recent establishment of fever hospitals, and the benefits which they are now admitted to confer, is calculated to afford a useful lesson to many, who placed at the head of our public institutions, presume, that all is already perfect, and oppose themselves to useful measures of farther security and prevention.*

The utility of FEVER hospitals considered with a view to the prevention of the dissemination of contagion, therefore consists in withdrawing Typhus patients from their own crowded and ill ventilated dwellings, where the disease would be multiplied and diffused, and there can be no doubt, that by this precaution, the health of the community has been preserved, and the ravages of this very formidable malady, have been most happily arrested. We must not, however, in our zeal for these institutions, forget, that all these benefits may be obtained by any general hospital, and there can be no doubt, that all hospitals may with perfect safety to the other patients, and to the attendants of the hospital, admit persons affected with fever; but their admission must be proportioned to the size of the hospital, the number of its wards, its situation, and the state of its ventilation: for the records of almost every hospital will prove, that under these restrictions, this step may be taken with perfect safety to others.

During

During the three years, (from 1800 to 1803 inclusive,) of my attendance at the large Edinburgh Infirmary, I do not remember an instance of the contagion of fever communicating itself in the hospital to the numerous class of physicians, pupils, and others, who frequented it; because fever patients were there scattered through the house, and their infectious effluvia were not accumulated in any one place. I do not know any one *fever* hospital, and I have visited several, of which the same impunity could be asserted.

Should it however be said, that by introducing fever amongst those labouring under other complaints, we subject them to the danger of infection: let it be remembered, that the atmosphere, which conveys febrile contagion to a person ill of another disease, cannot impart health to one labouring under fever. The effects of the injury resulting from crowding people ill of the *same disease*, are not so evidently manifested to the *general* observer, as when fever is communicated to an iudividual not previously affected with it, but it is not the less true, that febrile patients when congregated together, are capable of injuring each other by their infectious effluvia, and by the deterioration which they otherwise produce in the atmosphere, precisely in the same proportion, as they would be capable of injuring the health of another not previously infected with this disease: And as we would be careful to avoid concentrating febrile contagion in the wards of *general* hospitals, our caution should be greater with respect to *fever* institutions; because the injury we do there, is concealed from observation.

In our precautions, therefore, for the general health, we must not forget the consideration which is due to the individuals we confine in fever hospi-

tals, nor to the nurses and physicians who attend them.

All species of contagious effluvia, acquire increased activity, in close unventilated rooms, and the accumulation of the miasmata, which are emitted, causes them to acquire a still more fatal virulence. By collecting therefore and crowding people together infected with fever, we concentrate and accumulate the infectious emanations to such a degree, that no person can enter such places without hazard ; while the sick who are confined in them, recover slowly, and the least irregularity or indisposition produces a relapse.*

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* The reports of fever hospitals in general, do not particularly specify the mortality amongst those who attend them. We hear occasionally in the public papers, of some physician, who, in the discharge of his duty at some fever hospital, fell a victim as they term it, to his humanity, when it should be said, that he *fell a victim to the hospital.*—His death is unfortunately considered as an unavoidable occurrence, and the true cause of it, remains unnoticed or unknown, and at all events, unremoved. Had I not determined against making any institution the subject of particular remark from my own observations, I could record many instances of hospital calamity.

The report of the select committee of the House of Commons, on the late fever in Ireland, speaks sufficiently on this subject :—

" Every medical person, including two apothecaries, connected with the south fever asylum (in Cork,) had an attack of fever—the apothecaries to such institutions, were general sufferers, the nurse-tenders also suffered, the greater number had attacks of fever, and some became its victims; other persons engaged in various offices with the sick, the fumigators of the house, and barbers of the hospitals were attacked, and it was evident, that persons occupied with attendance on the sick poor at the time, suffered in a degree of frequency, much exceeding that observed in any other class of people not similarly exposed!***In Cove, it extended to attendants at hospitals, a physician, one of the apothecaries, and some of the nurse-tenders

There is a tendency sometimes among physicians, as well as among people of other classes, to magnify the benefits of the institutions to which they are attached, and to conceal also their de-

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tenders were seized with the disease.***Six medical men were attacked with fever in the neighbourhood of Fermoy and Mallow, and two of them fell victims to it.—The nurses and inferior attendants at fever hospitals, suffered very generally, as well as other persons employed about these establishments.** The nurse-tenders in the hospitals of Tralee and Killarney, suffered without any exception, and the physicians received the infection, in a proportion, far exceeding that observed amongst other persons in the same rank in life.**The apothecary to St. John's hospital, (in Limerick,) had three attacks of fever. All the nurse-tenders and house-keepers suffered in different degrees. This hospital has so often changed its nurse-tenders, chiefly from this cause, that it has had 63 within the last six months. Four of the nurse-tenders, I am informed, were lying ill of fever, at the time of my visit.—At Clonmell, five medical attendants were attacked; an active, zealous and humane governor caught the disease, and all the nurse-tenders were attacked; two medical gentlemen died of it. The surgeon and apothecary had both been ill of fever, during last April, and a physician and a nurse-tender laboured under it at the time of my visit.

In the Waterford house of recovery, seventeen nurses and servants of the house, have been attacked with fever, within the last 14 months, four of them have been attacked twice or thrice, within the above period."

See Dr. Barker's Report to the Irish Government, on the state of Fever in Ireland.

"The nurses and other servants of the different fever hospitals every where, contracted fever, and in many instances, the medical attendants, also. At Kilkenny, the house-keeper, nurses, and most of the servants had the disease repeatedly, during the epidemic; the apothecary and his assistant, died of the fever; in short, no person connected with the hospital, escaped, but one of the physicians. It is necessary to state, that the house of industry at Kilkenny, had been converted into a fever hospital, for which, it was ill suited. The dormitories which had become fever wards, although clean and cheerful, and not crowded, were not sufficiently ventilated.

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fects, least their own reputation might suffer in the promulgation. We are told on all sides, of the rapid recovery which fever patients make on their

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They had neither chimnies, nor ventilators ; and, although *I have no doubt, the windows and doors were generally open, yet this is not enough to secure proper ventilation in a fever ward.* It must be admitted, that the disease was contagious in private houses, *only* where cleanliness and ventilation were neglected or unattainable.**All who were employed in attending the sick in hospitals, were affected by it. It was fatal to a physician and two apothecaries at Dundalk, who attended the fever hospital at that town.

In the hospitals of the house of industry, there were till lately, 170 persons engaged in attending the fever patients ; from which part of the establishment, within the last eighteen months, have been furnished 198 cases of fever. No clinical clerk, apothecary, or unseasoned nurse or servant had escaped ; and some had the fever three or four times. Dr. Macloughlin a learned and scientific physician, died of fever, which there is every reason to think, he caught in the exercise of his office of inspector. Similar observations have been made in the other hospitals ; yet I have not heard of one instance, of a second individual of a family in the upper ranks in Dublin, being affected with the epidemic fever, such security do cleanliness and ventilation afford."—*Dr. Cheyne's report to the Lord Lieutenant on the state of Fever in Ireland.*

"Of nine physicians who have acted as permanent physicians to the fever hospital in Cork-street, since its foundation, (1804) five have had contagious fever, and two of the five have died of that disease—of the four remaining, two had contagious fever previous to their connection with the hospital—of eight apothecaries, one only escaped—Of the nurses employed in the hospital, every individual, as far as I can learn, who has resided for a year or upwards, has had contagious fever, and some have had the disease three or four times—none of the physicians or apothecaries, however, had the disease more than once hitherto."—*Medical Report of the Sick Poor Institution, Dublin, for* 1817, *by Dr. O'Brien.*

It would be rash perhaps to assert, that none of these disasters would have occurred, had the hospitals been properly ventilated. The nurse-tenders must necessarily, under any circumstances, be peculiarly liable to contagion ; but when we consider

their introduction into the spacious wards of a well ventilated fever hospital: but when these wards are *crowded,* when relapses become frequent, when the attendants are seized with the disorder, and when the mortality is great, we then hear of the malignity of the fever, the advanced stage of the disease in which the patients are admitted, we are not told that this so much vaunted *hospital, is itself the cause of their death.*

That its polluted atmosphere forms a powerful source of new infection, which heightens the malignity, aggravates the symptoms, accelerates the progress, and presents the most formidable obstacles to the favourable termination of the malady.* How in fact, can it be otherwise, when we review the actual condition of many of our fever hospitals, *when crowded from the disease being epidemic,* we there see the wards filled with patients, labouring under a contagious disease, envelloped in a close, foul, and stagnant atmosphere, which is every moment becoming more dangerous and offensive. In such a polluted and tainted air, the

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der the safety with which they perform their duties in the higher walks of life, it is fair to conclude, that adequate ventilation would have afforded them security.—If, therefore, those who occasionally visit those institutions, imbibe the infection, what must be the inflence of the polluted atmospheres, on the sick, who habitually respire them.

* In the institution for the cure and prevention of typhus fever, in the metropolis, according to Dr. Bateman's evidence before a select committee of the House of Commons, it appears, that from 1803 to 1818, 2,067 cases of fever were admitted, of this number, 212 died, that is about 1 in 9.

The number of deaths, must be considered in this instance, as very great, and can perhaps be fairly referred to the bad state of the air of the hospital, proceeding from its imperfect ventilation.

most powerful febrifuge remedies lose their efficacy.* The attendants on the sick, cannot, under such

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* Doctor Jackson had such long and extensive experience in the diseases of the army, that I have been led to extract the following facts and observations from his "Sketch of the history and cure of contagious fever," published in 1819,—as powerfully illustrative of the great injury, resulting from the crowded state, and imperfect ventilation of barracks and military hospitals.—In the extracts, which I have made so largely from the above mentioned treatise, as well as from other works of the same author. I have not alluded to his peculiar opinions, respecting the treatment of fever; my object being, merely to afford to the reader, the great extent of disease, resulting from artificial causes; and also, the author's opinion of the great cause of the evil.—My extracts being therefore directed to this object alone, are necessary desultary, but the reader may rely on their accuracy, and the facts and opinions which I have quoted, are really well worthy of attention from those, who have it in their power to remove, that cause of the disease, which this experienced medical writer, has had such frequent occasion to refer to.—

"These receptacles of sick," (hospitals) "are formed for the ostensible purpose of saving human life; they are in a great number of instances, to be numbered among the causes, which principally contribute to its destruction. The contagious fever of armies, is not a fatal disease in its own nature; that is, as left to itself in the open unsheltered field; its ravages are dreadful, even as treated by the best medical skill, in the crowded, and ill ventilated wards of general hospitals; the proofs are numerous, and explicit in almost every scene of service.****It was stated, that the general order, which was issued in Holland, in summer, 1794, implied, that every person who was incapable of military duty, should be sent to hospital, at every change of position made by the army. It was also stated, that orders were given, when the transports arrived at Cove, in 1795, that the troops of the expedition, should be immediately embarked, the sick separated, and sent to the hospital. The sick, in both cases, were thrown into apartments, in their own nature, unfit for the purpose of hospitals, or rendered unfit by excessive accumulation. The consequence was what might have been expected, viz. an aggravation of the symptoms of the disease beyond what was natural

such circumstances be safe, even those who have had the good fortune to recover, or to escape the contagion,

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natural to it, the generation and concentration of the contagious material to a state of high virulence, the subsequent dissemination of it through the army by a variety of channels. The mortality in the hospitals on the continent, in the years 1794 and 1795, and on Spike Island, in the beginning of the year 1796, *was prodigiously great.* The *sickness* no one acquainted with the scene, and capable of tracing effects to their causes, will hesitate to admit, was in a great measure *artificial*, the product of faulty arrangement; the *mortality*, it may be said with equal safety, was principally *artificial*, aggravated, if not wholly occasioned by accumulating sick persons in ill ventilated apartments, under the name of hospitals.***

The returns of hospital mortality constitute most important medical documents, as affording results, which enable us to form opinions relative to the causes which retard the recovery of the sick—and it is a cause of regret, that hospital returns are not frequent, and more properly digested.—Military general hospitals are necessarily always more crowded than civil houses of recovery; and as they are in the service, scarcely ever constructed expressly for the purpose of receiving the sick, the means of preserving the air in purity, are often inadequate, whence the atmosphere is sometimes much corrupted, as to be almost pestiferous and adverse to life in such an extraordinary degree, that death takes place suddenly and unexpectedly, not untrequently without ostensible appearances of danger. The mortality is here artificial, viz. the necessity of living in an atmosphere deprived of the principle, which stimulates the effective action of life; in confirmation of which, it is observed, that sick of the same description, who live in detached quarters, in barns and hovels, or even under hedges in the open air, die in a comparatively small proportion, though the symptoms of the disease, are often of the severest kind.

The sick of a division of troops, placed under the command of the Earl of Moira, for a special service, were collected in a granary at Southampton, about the beginning of the year 1794. The proportion of deaths to discharges from that resceptacle is not known to me with official correctness; I am safe in saying that it is not less than one in six. It was materially lower among such as were kept at the regimental infirmaries.

The mortality of the disease under view, was not great inherently,

contagion, have no security that they will not in their turn be infected. Their continuance in such a

herently, it became great by crowding the subjects of it, into ill ventilated hospitals **The mortality was greater in the general hospital at Southampton, than in the different hospitals in the vicinity. The general hospital at Southampton, was amply provided with every comfort *except pure air*, that sick men could require, and that England could supply.**I do not consider it rash to maintain, that mortality would have been less than it actually was, if the sick of Lord Moira's army had found no other shelter than the lee side of a hedge, and no other covering or comfort, than a blanket or a jug of water. The assertion is bold, but it is true, and easily understood. A granary, or malt-house of several stories, the apartments low roofed, imperfectly ventilated, every niche occupied by a sick man's cradle, and it will not fail, under the best care and management of the ablest physicians, to become a hot bed of infection. Such, in fact, it became; the infection which was virulent, extended to nurses and attendants. The mortality exceeded the ordinary mortality of the disease, as left to its own course in the *open air*, and scattered quarters, and it exceeded it, obviously by mistaken care, and ill considered kindness, that is *crowded wards*.

The mortality from contagious fever is known to have been enormously high in general hospitals, on the continent, in the latter end of the year 1794, and the beginning of the year 1795. The precise proportion of deaths to discharges is not, perhaps known to any one. It was stated by a military officer of rank and observation, who was stationed at Rhenen on hospital duty in the year 1794, to have amounted to three out of five of those admitted. There is reason to believe, that it was not under one in five at any of the great depots in Holland. It was materially lower in most of the regimental infirmaries. A proportion of the sick, of what was called the St. Domingo expedition, was collected into the barracks of Wesmoreland Fort on Spike Island, at the Cove of Cork, in Ireland, in the latter end of the year 1795, and beginning of 1796. The official return is lost. I am safe to say, from memory, that mortality was not less, if so little, as one to five among those who were received into the barracks in the Fort. It did not amount to one in fifty among those who were received into the sheds and huts which were on the outside of it.

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a morbid and tainted air, renders them always liable to the disease.

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The persons recruited for regiments in the common manner, were collected at Geneva barracks, and from thence conveyed to England, directly to the depot (in the Isle of Wight,) in government transports. They generally brought with them, a contagious fever, either in activity at the time of their arrival, or latent in their persons or their clothes.—Whether the offspring of Geneva barracks, or caught in an infected ship in the voyage, does not particularly concern the present subject; the fact is positive, that few detachments came to the depot, unless where the passage had been very short, altogether free from sickness. In some detachments the sickness was considerable, and generally in less than two weeks from the time of landing, upwards of one-third of the whole entered into the hospital ill of fever—the fever of the kind common in gaols, crowded and foul ships.

In the sleeping rooms of the barracks of the army depot at the Isle of Wight, there was no place for fire: the rooms were crowded to the utmost extent of crowding. From condensed breath, excessive damp, *and defective ventilation*, the walls in the mornings were covered with moisture, which trickled down their sides, in small streams—the hours allotted to sleep, thus may be said to have been spent in a steam bath.** The sleeping apartments were as much crowded as the 'tween decks of a transport ship, and the effects upon health, may be supposed to have been similar.**The proportion which the sick bore to those who were not sick, was high, nearly 1 in 4 during October, November and December.

The hospital at Chatham, which is the last constructed of the military hospitals, and consequently, the one, in the design and construction of which, it naturally would be supposed, all the lights of science and experience would have been employed,** is in respect to ventilation, in such a state, that the sick is in the same circumstances, as if he were in a cellar six feet under ground, for he is surrounded on every side, by a continued wall, six feet high. The means employed in ventilation, viz. air holes, or the depression of the upper part of the windows, are not well contrived for the purpose."—*Dr. Jackson on the constitution of the medical department of the British army in* 1801.

Report

The sick placed in them, the physicians and nurses who attend them, have alike fallen victims to fever in those places, erected to prevent its communication and diffusion, and the wretched patients brought from their homes to be immersed in this pestilential atmosphere, in many instances resemble the inhabitants of an infected town, surrounded by a cordon of troops, and may in truth be considered *as victims sacraficed for the security of others.* " Whoever, (says an intelligent writer*) has frequented the miserable habitation of the lowest classes of poor, and has seen disease aggravated by a total want of every comfort arising from suitable diet, cleanliness and medicine, must be struck with pleasure, at the change on their admission to an hospital, where these wants are abundantly supplied, and where a number of skilful persons are co-operating for their relief. On the contrary, when he walks through the long wards of *a crowded* hospital, and surveys the languid countenances of the patients, when he feels the peculiarly noxious effluvia so unfriendly to every vigorous principle of life, and compares their transient effect upon him, with that to be expected by those who are constantly breathing and imbibing them at every pore, he will be apt

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Report of the special board of medical officers, Sir John Hayes, Dr. J. Hunter, Mr. Weir and Dr. Pinkard, on the hospitals at Parkhurst, laid before his Royal Highness the Commander-in-Chief.—" These diseases, (viz. fever, dysentery, measles and scarlet fever,) would, at any time, prove the cause of considerable mortality; but their destructive effects, are greatly increased, by the foul air of the wards of the hospital, which agravates all their symptoms, and renders them, though simple and mild on their first admission, in the end, malignant and fatal."

* Aikin on Hospitals.

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to look upon an hospital as a dismal prison, where the sick are shut up from the rest of mankind, to perish by mutual contagion."

In offering these observations, it is very far from the writer's intention to undervalue the benefits which are derived from these institutions, for the reception of the poor labouring under Typhus.—They save many who would otherwise perish, and *under proper regulations*, serve no less for the cure than for the suppression of the disease.

It is not against their use, but their abuse, that the author wishes to guard, and it is only after a very extensive survey of a variety of these establishments, and from a numerous collection of the best authenticated particulars connected with them, that he ventures to assert; that in innumerable instances, from their over-crowded state, and defective ventilation, they have produced the very evil they were instituted to prevent. But humanity requires no victims, and even handed justice demands, that in taking precautions for the general health, we should not, if possible, subject any individual to the danger of infection, or to the influence of any agent that might aggravate it when received.

Too much care cannot be taken to guard against the practice of crowding a number of fever patients into one house or ward, for there is no more formidable infection than that which is produced by a great number of persons afflicted with typhus fever. There is no greater obstacle to the recovery of the sick than living in an atmosphere thus infected, and every fact concurs to prove, that there is no more powerful agent in their recovery than the respiration of pure air; and innumerable instances might be recorded to prove, that no hospital, no care, no medicine,

no skill, no comfort, can compensate for the loss of this genuine cordial of nature.*

In estimating the policy of these establishments, we must consider the evils they produce, as well as the benefits they confer, to render them still more useful, it is necessary to point out their defects, in order that these defects may be removed. It is admitted on all hands, that patients removed to the spacious and well ventilated wards of an hospital, from their own dirty and confined dwellings, constantly even without the exhibition of medicine, evince signs of amendment. There is also a strong testimony to shew, that when we concentrate fever patients together, we diminish their chances of recovery, and *we form a new source of danger for others.*—These are not theoretical opinions, nor imaginary evils, every fever hospital testifies to their truth, and to their existence

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* "Those who were unable to proceed from having been seized with fever, were placed in huts, which were built over them, as they chanced to lie against a wall or ditch. They were supplied with water and butter-milk by the poor in the vicinity; if there were resident gentry, with porter, wine gruel, and medicines. The mortality was not so considerable among patients of this description; they were much better circumstanced as to separation and ventilation, than if they were lodged in the inner chamber of a close cabin; and their attendants ran less hazard."—*Dr. Crampton's report on the state of Fever in Ireland.*

"When a stranger, or a labourer, who had no cabin of his own, took the disease, it was quite customary to prepare a shed for him by the way-side which was done, by inclining some spars or sticks against a wall or bank of a ditch, and covering them with straw. Under these sheds, which the rain penetrated, the patients lay on a little straw; and cruel, though such treatment may appear, it was found by experience, that many more in proportion died in the cabins than in the sheds; indeed, some medical practitioners thought so favourably

ence. These institutions have been only of recent establishment, and the mischiefs which they have caused have, from the very nature of their constitution, been concealed from transient and superficial observation.

A mass of evidence, sufficiently great, has been at length brought forward, from various sources, to shew, that crowding fever patients together in one ward, is attended with danger to themselves and to others, and the history of these institutions themselves sufficiently testifies to the existence of the evil. If in well aired rooms, there is no infection from fever; let fever hospitals also participate in the safety produced by adequate ventilation; and if pure air be the best medicine for those afflicted with this disease, let our means of ventilation be so regulated as to afford them an adequate supply of this salutary fluid. We shall thereby leave nothing to be wished for in the internal œconomy of these excellent institutions, and

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favourably of the sheds, that they recommended them to those who might have remained in their cabins."—*Dr. Cheyne's report on the state of Fever in Ireland.*

"His Majesty's frigate *Gloire*, to which I was appointed Surgeon, lost while cruising in the West Indies, in 1809, upwards of eighty men, of the same disorder, (petechial fever); it was remarked, that notwithstanding the great number of sick, those persons who slept immediately under the hatchway, *where a constant ventilation was going on*, although within a few inches of persons ill of the same fever, were not affected by it."—*Dr. Granville's letter to F. Robinson, M. P. on Plague and Contagion, p.* 14—1819. It is evident from this fact, how many lives would have been preserved had the frigate been adequately ventilated.

Among the many proofs of the efficacy of pure air on the sick, the reader may be pleased to see one, from perhaps the most scientific traveller of this, or of any other period: HUMBOLDT, in his personal narrative, informs us, "That a sailor, who

and the important benefits which they confer will not be over-clouded by the reflection that our inattention has, in any respect, rendered them the mansions of disease or death.

Fever, under some one or other of its various forms, is one of the most frequent among the diseases of armies; its generation, and its subsequent mortality, result from the operation of *artificial causes*, which are fortunately also within our means of prevention.

If, therefore, it appears, that our barracks at home and our encampments abroad generate this formidable disease, and that our military hospitals, under all circumstances, give it increased malignity and diffusion; it cannot be supposed that when the means of redress are within the power of those who preside over these respective establishments, that they will any longer hesitate to employ them.

In considering the operation of those causes which contribute to contaminate the atmosphere, it may not be amiss to make a few observations on those agents, which are employed to dis-infect it,

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who was near expiring, recovered his health from a circumstance that is worthy of being mentioned; his hammock was so slung, that there were not ten inches between his face and the deck. It was impossible to administer the sacrament in this situation, for, agreeable to the custom on board Spanish vessels, the viaticum ought to be carried by the light of tapers, and followed by the whole crew. The patient was removed into an airy place near the hatchway, where a small square birth had been formed of sail-cloth; here he was to remain till he died, which was an event expected every moment; but passing from an air extremely heated, stagnated, and filled with miasma, into fresher and purer air, which was renewed every instant, he gradually revived from his lethargic state, and his recovery dated from the day when he quitted the middle deck."

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as well as to afford a brief outline of the phenomena of the generation and diffusion of CONTAGION.

The term *infection* or *contagion* may be indiscriminately used to signify any substance, which, whether imbibed by the lungs, or the skin, produces a disease of a peculiar character, according to the nature of the infection which is applied. There seems to be no just grounds, nor any benefit arising in making a distinction between contagion and infection. Whether the matter which produces the disorder is conveyed by the air into our lungs, or applied in a more concentrated form to our bodies, it acts in both cases by contact, and only differs in being in a greater or less state of dilution. Some diseases, such as measles, small-pox, and others, are indiscriminately communicated either through the medium of the atmosphere, or by the direct application of matter to the skin.

The particles of infection being in general of a very subtile nature, and seldom, if ever, falling under the cognizance of our senses, the investigation of their origin, nature and mode of action, has partaken of all that vagueness of speculation to which such subjects usually give rise.

Without however, at all adverting to the various theories which have at different times been brought forward to explain the origin and constitution of these formidable substances; it will be sufficient to state, that contagious virus appears to be caused by the elements of animal matter in some new and peculiar state of combination. Experience has fully demonstrated, that animal matter does cause contagion. The virus of the small-pox, of the plague, and of other diseases, is known to be an animal substance, and is in fact, derived immediately from the body itself, and there is reason to believe, that most, if not all, species of contagious virus are either

either emanations from the body, * or formed by the decomposition of animal or vegetable matter. We have also abundant proofs of the infinitely varied effects which nature can produce by change of proportion in the relative constituents of bodies, and this too, in quantities too small to admit of calculation.

That there are several distinct species of contagions, is evident from the different diseases which they produce; the infection also, resulting from these diseases, may be collected, concentrated, and preserved, and these substances which have imbibed it, become enabled to communicate the distinct disease, of the particular contagion which they have imbibed.—Though the sources of most of these contagions, have been covered by an impenetrable veil; the human body may truly be considered as the hot bed, in which these monstrous compositions are multiplied, fructified and diffused.

As contagious miasmata are emitted from the bodies of the sick, or are generated by the effluvia of persons crowded together in confined places; one of the first measures, which necessarily presents itself, is, to secure by a proper system of ventilation, a free ingress and egress of air out of the crowded or infected apartments, in order that the effluvia may be carried off with sufficient rapidity, so as to prevent their deposition, and consequent preservation on the walls and furniture of

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* It seems to be a general law of animal nature, at least among the *mammalia*, that the accumulation and stagnation of the exhalations of the living body produce disease. The *glanders* of horses arise only in large stables, and the *distemper* of dogs, in kennels. During the American war, live sheep were sent across the Atlantic. In a few weeks, in consequence of being crowded in a ship, they all died of a febrile disorder.

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the house, and also, to dilute them by fresh air, that they may be respired with safety. For contagions, like all other poisons, become more virulent, in proportion to the quantity which we imbibe, and are rendered harmless, by adequate dilution. The virulence of contagious effluvia, being dangerous in proportion to its concentration; the atmospheres of all sick places, and more particularly of fever hospitals, become necessarily more noxious and dangerous, as they are loaded with the matter of infection, while, on the other hand, when the contagion emitted, is largely diluted with fresh air, it becomes too weak, to produce its specific effect.

It is only of late years, that medical men, have generally adopted these plain and simple ideas, of the generation, diffusion, and prevention of contagion, and obvious as they may seem, they have not yet obtained sanction from all, and what is more to be regretted, they have not had the full influence in a practicable point of view, that might reasonably have been expected. We yet meet with medical men, denying the existence of contagion in typhus and other diseases, and speculating on some recondite and imaginary property of the atmosphere, as the sole cause of its generation and diffusion; even parliament, has within a recent period, given a reward of £5000 for destroying contagion by mineral acids, as if it could not be sufficiently well carried off, by the combined operation of cleanliness and ventilation.

It would be useless now to enter into the discussion of the different means, which have, at remote, as well as in the present times, been proposed for the destruction of contagion. The antipestilential vinegar of the four thieves, was at one period in great estimation. The practice of

kindling large fires in the streets, with the view of destroying pestilential miasmata, may be traced up to the time of Hippocrates. The fumes of burning charcoal, have been also employed with this view, and the combustion of tar, and of various odoriferous substances, such as benzoin storax, pastiles, &c. are yet in high repute with many, who seem to think, that by scenting the air, they destroy the infection, when in fact, they merely deceive the watchful vigilance of the organ of smell, by substituting for the disagreeable fetor of an infectious atmosphere, an odoriferous, but not a wholesome perfume.

Of all the different agents, which are supposed to have, not only the power of purifying infected air, but even of destroying the infection itself, the fumes of the mineral acids have been the most recently celebrated. Dr. John Jonstone of Birmingham, informs us, that his father, employed muriatic acid gas, to destroy febrile contagion in 1756. Morveau applied mineral acids for this purpose in 1773, and Dr. Smyth used them in 1795. His first experiments were made in the Union; an hospital ship, and afterwards in part of the Russian squadron in Sheerness.

We have no decisive facts to shew, that these agents disinfect the atmosphere, and it appears very questionable, whether the degree of concentration necessary to enable these vapours to destroy any animal matter, floating in this fluid, would admit of their being respired with safety.—The good effects attributed to these vapours, may with more propriety be referred to the ventilation that is subsequently produced.

It is surely, better at once, to expell the impure atmosphere, than to send in an array of nurses into a sick ward, with foaming pipkins in their hands, diffusing acid and irritating vapours

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to suffocate the patients, under the idea of disinfecting the atmosphere ; and it is to be presumed, that lime washing, and the liberal use of soap and water, will destroy any contagious matter, that may be deposited on the walls, clothes, or furniture, more effectually than it could be accomplished by vapour acids.

Dr. C. Smith, in his work on the gaol distemper, speaks lightly of the effects of lime washing, without adducing any substantial argument against the utility of a measure, sanctioned alike by experience and authority, and recommended also by the facility and cheapness of its application, and the permanence of its action : for it not only destroys the contagion already on the walls, but it appears to exert a considerable influence in destroying the infection, which may be subsequently deposited.

Admitting even all the beneficial effects attributed to these fumigations, it must be admitted, that they are only occasional in their action, being only used when it is considered, that there is an accumulation of contagious matter : whereas a proper system of ventilation would prevent this accumulation, by carrying off this impure air with as much rapidity as it is vitiated, and refresh the patient also, not with acid fumes, but with an uninterrupted current of pure and wholesome air.*

In reviewing the maladies of hospitals, and in considering the causes which contribute to lessen

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* Dr. Trotter, whose experience on this subject, must have been great, gives his decided opposition to all noxious and unrespirable

the benefits of these valuable institutions, it appears, that the helping hand of enlightened charity, is in many respects yet wanting. They have in general been erected by the co-operation of humane individuals, moved by the presence of distress, but unacquainted with their necessary internal arrangement. The architect may construct the most magnificent edifice for the reception of disease, and benevolence may afford the most liberal donations for its endowment and support; but unless the edifice he constructed with a view to its ventilation, neither the beauty of the building, nor the most liberal supply of medicine, nor the most nutritious diet, will render it a temple of health.

The several parts of this benevolent system, constructed at different periods and places, to relieve the varying circumstances of wretchedness, re-

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respirable gases, he calls it a distorted philosophy, to introduce those lethalic vapours into a sick chamber, that ought to be filled with pure air alone. "Of the substances used (says he) in the fumigating process, I have nothing to say in praise. I know no condition of a ship that can stand in need of these vadours. I do not think they are harmless only, but that they are hurtful.***During the diffusion of the nitrous gas, between decks, on board the Niger, it created general coughing, headache, which did not go off, till the people had been sometime exposed to the air," and in another part of his work, he says, "We conceived, that *trusting* to fumigation in former times, has often paralized the arm of war, and we at this moment think, that the nitrous gas *has, and is doing harm!* Instead of relying on these silly practises to destroy contagion, it is better to let our sick breathe pure atmospheric air, as the best security, instead of stifling them with the fumes of mineral acid vapours, and other noxious gases. Let nurses understand, that if they keep the sick clean in person and clothes, keep the room well ventilated, they follow the means not only of recovering the patient, but of securing themselves. Nothing can be more pernicious, than allowing filth to accumulate, that it may be corrected by chemical agents."

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quire a more minute and enlightened examination, to render them equal to the ends for which they were distinctly designed. As asylums for the sick, these institutions may be truly said, to form the most useful manifestations of benevolence, and they certainly constitute the finest monuments of national wisdom and humanity. But however, sensibility may be gratified with the number of patients within their walls, we must reflect, that the value of these institutions do not rise in proportion to the number of sick which they *contain*, but to the number which they *relieve*. That it is conferring no benefit on a poor creature, weighed down with sicknes, to immerse him in a fœtid atmosphere, which adds to the malignity of his disease, and which, renders the skill of the physician, and the comforts of the hospital alike unavailing.

The observations with respect to hospitals in general, apply with still greater force to those appropriated for the reception of our sick and wounded seamen and soldiers, who, independantly of any considerations of humanity, have the strongest claims on our attention. In erecting a MILITARY HOSPITAL, the government discharges an *obligation*, in erecting a civil one, we perform merely an act of *benevolence*.

When we consider the immense expense attending military operations, the sum of money which each soldier costs the nation before he arrives at the field of battle, the numbers which disease has swept away, and how many of our best concerted military enterprises have been frustrated by the diseases of our troops, produced by confined air in our barracks and hospitals,* we should truly consult

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* Sir John Pringle, in enumerating the causes of mortality in

consult the principles of œconomy, by any expenditure, that would contribute to their preservation.

"No expense, (says an animated and experienced surgeon) should be spared; for these are men who have entitled themselves to your care, by every claim which man can have. You would willingly expend your own fortune in such a cause, then do not grudge to employ the revenue of the state, for it is employing and not abusing it! this is not profusion, but the wisest and best œconomy: if in the course of a few weeks, sixty men die of the disease in your hospital, government has lost a sum, which would trebly buy your hospital itself! The gross value of so many men in money, as they are reckoned on the muster books, being full fifteen thousand pounds."*

Navy.

There is no place where so many causes contribute to vitiate the air, as in a crowded vessel, nor is there any place where the ill effects of impure air, have been more decidedly or fatally

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in the army, has represented hospitals themselves, *as one of the chief of them, and very justly.* It is conformable to all medical experience, that where large bodies of sick are brought together, disease is frequently aggravated, and contagion sometimes generated.—*Sir James Macgrigor's Medical Sketch of the British Army.—Medico Chirurgical Transactions. vol.* vi.

Among the *chief* causes of sickness and mortality in an army, the reader will little expect, that I should rank the *hospitals* themselves, though intended for its health and preservation, and that, on account of the bad air."—*Sir John Pringle on the diseases of the army.*

* John Bell's principles of surgery, vol. 1. p. 117.

manifested.

manifested. In no situation is there so large a number of human beings confined in so small a space, as in a man of war, and when we consider the amount of their effluvia, as well as the exhalations from the bilge water, cargo, &c. it must be admitted, that there is no place that requires a more effective ventilation.

Whenever the vessel consists of two or more decks, the air in proportion, will become more impure, as its circulation is necessarily more impeded. It has been a subject of complaint, with all writers on maritime diseases, that the arrangements, made for the ventilation of ships, have not kept pace with the great necessity of the measure.

When one or more hundreds of people lie on one deck, the space is not sufficiently ventilated by the hatches, even when they are left open. When the whole ship's company sleep at once below deck, which is the case in harbour, the evil of course must be proportionably increased; a fact that will be painfully confirmed by the sensations of those, who at night, or early in the morning, would venture between the close and crowded decks of even the best ventilated vessel in the service, and under circumstances most favourable to the full action of the means employed to produce a full circulation of air.

The ventilation produced by the usual means, is not only imperfect in itself, but its action becomes constantly suspended from many causes. At night, the ports are lowered down, and the chief places for the crew to draw air from, are the small scuttles, hatchways, gratings and wind sails. The scuttles, and a few ports opened *occasionally* for ventilation, produce streams of air disagreeable to those near them, they consequently close these inlets; but even when open, the currents proceeding from them, do not sufficiently pervade the

the vessel, unless when the wind blows directly into them. The hatchways, even when open, are not adequate to ventilate the vessel, but in stormy weather, they are constantly shut down, and in wet weather, covered with tarpaulins, so that even the imperfect ventilation effected by their means, is liable to interruption. The action of wind-sails are also imperfect, and it is liable besides to be suspended from many causes.*

When the wind blows hard, they are forced from their perpendicular direction, and form an angle, which closes up the entrance to air, when there is too little wind to inflate them, they produce very little effect. From interfering with the ship's navigation, and not being suited to all kinds of weather, they are often obliged to be taken down, and being troublesome to keep trimmed, they are seldom used during the night. Thus, in a storm, when the hatchways are shut, in a calm when the circulation of air is peculiarly wanted,

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* "What are called wind-sails, that is, wide tubes formed of canvass, and extended by hoops, into the form of a cylinder, which pass from the external air into the lower part of the ship, through the hatches, have been in use, time out of mind, for freshening the spaces between decks,. But these are very imperfect ventilators, for they cannot be let down in bad weather, when the hatches are shut, at which time, they are most wanted. They also admit such large volumes of cold air, that they cannot, with safety, be introduced to those spaces where the men are asleep. In order to obviate these imperfections, it has been common, for the last thirty years, to put in practice a contrivance borrowed from a French frigate, consisting of square wooden trunks, for which brass tubes have been since substituted, running from the hold or lower deck, and terminating in the open air. Instead of air tubes in this situation, it has been of late judged more advisable, to place a funnel vertically, near the middle line of the ship, before the foremast, leading through the forecastle deck."—*Sir Gilbert Blane, on the health of the Navy.*

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and at night, when the spaces below are literally stowed with human beings. Wind-sails are of no service, when ventilation is most required, and when indeed it is absolutely necessary, to carry off the exhalations of the crew who are sleeping below decks. Many also suffer when it is in action, more particularly the sick, from the unequal and impetuous descent of the cold external atmosphere, which is also too limited in its sphere of action, adequately to pervade the different parts of the vessel, when the air is vitiated by candles and respiration, and to carry off the effluvia, produced by the spirit, cheese, and provision rooms.*

If the quantity of watery vapour, which arises from one man in twenty-four hours, amounts to 50 ounces, the united discharge from one hundred men between decks, during six hours, will be 1250 ounces. We may from this, form a tolerably accurate idea, of the state of the air between decks, and of the necessary influence it cannot fail to have on the health of those who are immersed iu such a warm and humid congregation of noxious and impure exhalations.

The observations already made on the effects of respiring impure air, apply therefore, particularly to seamen, shut up in crowded and ill ventilated vessels. A general deterioration of health, and

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* "The air in the store rooms, situated in the fore part of the ship, especially the gunner's, becomes so foul, as frequently to be scarcely respirable, and every thing in them decaying and rotten. The powder too is greatly injured by the humidity and foulness of the air.**The fore masts of ships, are found more generally decayed than either of the others, and this is undoubtedly occasioned by the foul and humid air, with which the commonly unsound part is almost always surrounded."—*Trotter's diseases of seamen.*

disposition to disease, consequently result from their being deprived of a due supply of vital air below deck. Instead therefore of attributing that dreadful disease called the sea scurvy, to the sole influence of salted provisions, we shall rather trace its appearance in a great measure to the influence of impure air; and every mariner has concurred in stating, that the health of the crew, and the absence of this formidable malady, depended on the good ventilation of the vessel.* In two ships, equally well provisioned, that will be most healthy, whose ventilation is best attended to, and the crew of the one will be cut off by the ravages of sea scurvy, while that of the other though living on the same kind of diet will escape.

The continual use of salt provisions on shore, and in a good climate, produces very different effects from what are evinced on board ships, where the influence of putrid air is in full action and activity, and we may trace the production of the

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* "It appears from Dr. Lind's statement, that 1457 men ill of scurvy, were sent to the hospital from the Channel fleet, in 1780, and it has been known to arise in ships while at anchor, under the daily use of small beer. Nay, it has been known to arise among prisoners of war, living entirely on fresh diet, *and solely imputable therefore to confinement in bad air*, a dull uniformity of life, depression of spirits, and indolent habits, naturally belonging to a state of captivity. This happened at Portchester Castle and Norman Cross, towards the beginning of the revolutionary war, before those arrangements were put in practice, which afterwards so effectually secured their health. The like happened about the same time in a prison ship adjoining to Portchester Castle, but it was remarked to break out sooner, and to a greater degree, in the ship, than in the castle. Sir James Macgrigor in the medical and surgical journal of Edinburgh, for 1805, has recorded a curious instance of scurvy arising at land, under the use of fresh provisions, and it appears from Pliny, that this disease affected also the Roman armies in Germany."—*Sir Gilbert Blane on the health of the Navy.—Med. Chir. Trans. vol.* vi.

sea

sea scurvy in particular, and of naval sickness in general, to the noxious vapours, emanating alike from the bilge water, and the inmates of the vessel, weakening the vital powers by progressive debility.

When this disease appears amongst mariners it commences long before its presence could be fairly attributed to the influence of salt provisions, and it exhibits also very different symptoms from those which characterise it on shore.

Scurvy, as it affects landsmen, exhibits merely crustaceous and other cutaneous eruptions, that have no similitude whatever to the livid and sanguineous ulcers, evinced when this disease appears at sea, together with febrile and other characteristic affections. So that in fact, there is no resemblance between the disease as it appears on shore, and the sickness which is so destructive to seamen.

Few maratime diseases have been more fatal than this formidable malady,—it has been said, that more British seamen have been destroyed by the scurvy alone, than by the casualties of the sea, and the united efforts of all our combined enemies.*

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* "During the last war, says a very ingenious and able author, (Mr. Thompson,) the scurvy prevailed greatly in the fleet, under the command of Sir Edward Hughes, in the East Indies, and may be accounted one material cause of the want of success in that quarter of the world.—I was informed by an officer, who served in that fleet, that the crews of almost all the ships, were so weakened by the scurvy, that on every occasion, when they came to action, they had not men sufficient to man their guns; but particularly that in the last action, not one ship in the British line, had men, nearly sufficient to man the guns properly, so many were ill of the scurvy.

The scurvy prevailed likewise considerably in the fleet under

Lord Anson says, he lost four-fifths of his people by this disease, and those who will refer to the very eloquent history of the voyage of this distinguished navigator, will find a very affecting picture of the dreadful sufferings and mortality arising from this deadly scourge of seamen*.

Without, however, adverting to the earlier periods of naval history for proofs of the effects of impure air in producing this disease, Dr. Lind informs us, that even in 1780, the channel fleet was so over-run with scurvy and fever, that it was unable to keep the sea after a cruise of only ten weeks†, and even the history of the late war, would

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der the command of Admiral Biron, when it arrived on the coast of America, in 1778.

Sir Richard Hawkins asserts, that in the course of twenty years, he knew ten thousand men to have died of scurvy."

* Anson's ship the Centurion, left England with four hundred men; there were only two hundred surviving on her arrival at Juan Fernandez, of whom only eight were capable of duty. In a very few days there would not have been strength remaining to carry the ship to her anchorage, and she would have been left adrift on the Pacific Ocean, in the same manner as the Oriflamma, a Spanish ship, on her passage from Manilla to Acapulca, some time in the last century, in which the whole crew perished from disease; and in this state she was discovered with the dead bodies on board.

† "On the 26th of October, 1778, the fleet under Admiral Keppel, came into harbour, and before the end of December, sent three thousand six hundred sick to the Haslar.*** In 1779, on the return of the channel fleet, under Sir Charles Hardy, into port, it became sickly; two thousand five hundred were in the month of September received into hospitals from it, and above one thousand ill of fevers, remained on board, for want of room in the hospitals.*** Within four months preceding the year, of whose diseases I am to state the account, six thousand and sixty-four sick had been sent to Haslar, and at the commencement of the year, there were two thousand four hundred and forty three patients in the hospitals.*** The preceding account gives the cases of patients received

would afford ample details of disease and mortality, that adequate care would have prevented.

"Air," says Sir Gilbert Blane, "contaminated by foul and stagnant exhalations, particularly those from the living human body, is the ascertained cause of typhus fever, known also by the name of the gaol, hospital and ship fever, which has been a more grievous and general source of

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received into the hospital during the third year of the war. Strong infection had continued during the former years, on board the receiving ships, which affected the ships going out, and generally the fleets on coming from sea into port; and a fleet of unusual magnitude, to which, in common with every department at the port, the hospital was disproportionate, from the strength of the enemy's combined fleets, rendered it imprudent to divide, had remained collected at Spithead during a great part of the winter. The effect of this extended through *the first five months* of the year, and there was not afterwards experienced, during the war, any such fatal sickness:—5539 cases of fever were admitted this year, of which above two-thirds were admitted the first five months. The proportion of deaths during the first five months, was one in eight; during the remaining seven (when they were less crowded) one in nineteen.

"1457 cases in scurvy are noticed.*** In August, after a ten weeks cruise, in the Bay of Biscay, when the beer, and all fresh provisions, had been exhausted, Admiral Geary's fleet returned to Portsmouth, with 2400 men ill of the scurvy.*** Of 1678 surgical cases admitted, 979, or much above one-half had ULCERS.—The gross number of admissions and deaths this year, as appearing by the agent's books, were—admissions, 11,732—deaths, 909, being in proportion of one to thirteen.

"Besides the sick here enumerated, *many scorbutics* were sent on shore from ships, who were taken care of by their own people, and no account of them was taken at the hospital."—*Extract from Dr. John Lind's letter, late Physician to Haslar hospital.*

"The combined fleet of French and Spaniards, when off Plymouth, in summer 1779, which was my first cruize at sea, were over-run with a contagious fever, which made them leave the channel."—*Dr. Trotter's Medicina Nautica.*

sickness

sickness and mortality in the navy, than even the scurvy. The dysentery, which stands next in order in point of fatality, is also generated and propagated by the want of cleanliness and ventilation."*

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* I have been led to extract the following observations, from a paper published by Sir Gilbert Blane, on the health of the navy in 1815. As well from the high authority of the author, as that he cannot be suspected of any bias to exaggerate the amount of the evil; on the contrary, the whole tendency of his paper is laudatory, and where he has not materials for praise, he indulges in favourable anticipations. The desultory and unconnected extracts which I have made, must, therefore, be in some measure, considered rather in the light of unavoidable admissions on his part, than of any disposition to censure. In making these remarks, it is very far indeed from my intention to throw any dispraise on a learned and experienced physician, to whom this branch of the service has been so considerably indebted. On the contrary, it appears to me, that by pointing out the advantages which the navy *has derived* from good regulations, and the very great diminution of the mortality which ensues from them, Sir Gilbert Blane followed the best means to attain the introduction of additional improvements. Those who permit themselves to indulge in violent and coarse invective do not usually obtain their object, they rather excite a spirit of resistance to their suggestions, and even give rise to some doubts of the accuracy of their statements. A man who writes under the influence of passion, and who indulges in the extremes of censure, naturally produces some suspicion of his candour, as well as of his judgment.

"The principal diseases which constitute sickness, and cause mortality on board ships of war in all climates, are scurvy and fever. To these may be added dysentery, *which prevails much* in tropical climates, and, above all, on the Indian stations. *(now these are the diseases which are most intimately connected with impure air.)* Since these disorders have been subdued in the European stations, pulmonic inflamation has been the most frequent and fatal disease.** By the return of hospitals at home it appears, that the pulmonic inflamation constitutes the largest head of mortality. The chief circumstances in a seaman's duty, which exposes him to this inflamation, is his being suddenly called *from the warm and close situation in*

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It is not necessary to recur to the writings of those who express themselves in strong and unqualified terms on the neglect of taking proper measures of precaution for the health of our seamen,

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which he sleeps, to take his watch in the night upon deck or aloft..... With regard to fevers, they are, by no means, subdued to the extent that scurvy has been. In some of the last years of the late war, there occurs in the surgeons' journals, some examples of fever being GENERATED *and propagated in ships to a great extent.* In a 90 gun ship, cruizing in the channel in 1805, there occurred one hundred and seventeen cases of fever, five of which proved fatal. In an 80 gun ship, which had been for some time at Plymouth, in 1806, during which, the men had indulged to excess in spirituous liquors ; a fever broke out on her first going to sea, with which 106 men were seized, of whom ten died. ..... A great proportion of the mortality of the navy is referable to the diseases peculiar to tropical climates, particularly in the West Indies; yet there are incontrovertible proofs, that fleets may serve on that station in a state of health, equal to that of any other part of the world. The mortality of seamen in the West Indies, during the American war, was trifling, when compared with what it has been at different times in the course of the *late* revolutionary war. It appears by records kept at the admiralty, that the naval force in the West Indies, in 1804, fluctuated from nine to thirteen thousand, in ships of all classes, whereas in 1782, the strength of the armament under Lord Rodney, fluctuated from twenty-four to twenty-five thousand; yet. there died more in the hospitals of the West Indies, in 1804, than in 1782. It appears from the surgeon's journals on that station at that time, that there was a proportional mortality on board of ships. In one frigate there were 170 cases of fever, of which twenty-six proved fatal on board. In order to recommend measures of future precaution, let us, if possible, detect the causes of this very great difference of sickness and mortality at different periods on the same station.—It is observable, that the mortality in fleets in the West Indies, has been by far more severe in those wars, in which there were great expeditions by land, as in that against Carthagena, in 1740, and these against Martinique and St. Domingo, in the first year of the revolutionary war. There was no large army transported from England, nor any expedition of importance undertaken dur-

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men, and who may be perhaps suspected of exaggeration. From the most favourable and mitigated accounts which have been offered us, it appears, that great disease and mortality yet ensue

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ing the three years in which Lord Rodney commanded in the West Indies. It is to this we trace the great difference in point of health, at different periods. The vessels that used to be hired for transports were, for the most part, very ill adapted to that service, generally overcrowded; and during their long passages, in consequence of contrary winds and other obstacles, *almost all* of them arrived in the West Indies, in a sickly state, from salt provisions, scarcity of water, but above all, from *accumulated infection*; and it has been matter of observation, that troops which were disembarked from the most crowded and infected of the transports, were those men who (though they had escaped illness on the passage) were attacked soonest and most malignantly by the fever of the climate. Sir Gilbert Blane proceeds to recommend farther attention to ventilation, as the means of preventing the recurrence of typhus fever: he says, 'that the employment of King's ships in the transport service, has been productive of great advantage, and that the improvements which have actually been introduced into the navy within these last forty years, in promoting the health of seamen, has added ONE-THIRD to the national force, and *substracted in the like proportion from the national expenditure.*'

"It is computed (says he) that two ships of war are capable of more service by the present system, than three of the same rate in former times. Here is a saving of one-third of the total amount of the national expenditure, besides what is saved in the recruiting service, which has been officially calculated to amount to fifteen pounds for each man, and of hospital expenses, which are estimated at five pounds for each man. This computation is, exclusive of the higher bounties, which would have been necessary, under the reduced stock of seamen, which a higher rate of mortality would have produced. Nay, it appears clear, from what has been before stated, that if the mortality during the twenty years of the revolutionary war had been equal to what it was in 1779, the whole stock of seamen would have been exhausted; in which case men would not have been procured by any bounties however exorbitant; for it has been stated, that if the mortality of 1813, had been equal to that of 1779, there would

from neglect of the proper measures of security. The *hospital sore or ulcer* produces great destruction in our fleets, fevers and dysenteries yet extensively prevail amongst them; and pneumonia is one of the chief causes of naval mortality,

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would have died annually 6674 men more than have actually died; which, in twenty years, would have amounted to 135,480, a number very nearly equal to the whole number of seamen and marines employed in the last years of the late war."

It affords me much pleasure to be enabled to add, that these most valuable improvements in the health of the naval service of the country have been effected by the agency of professional men amongst whom it is but just to notice Dr. Lind and Sir Gilbert Blane. The latter gentleman, in the paper already alluded to, proceeds to shew, from a variety of official documents, to which he had access, that the average mortality, from *disease* in the navy, amounts to about one in forty-two, which is *about double* of that of subjects of *the same age* in civil life. It is greater than that even of prisoners of war, which, in 1813, was one in fifty-five. It is also higher than that of the garrison of Gibralter, which is one in forty-nine —In his examination before a select committee of the House of Commons, on the health of children employed in manufactories, Sir Gilbert Blane says, "from some calculations I have made, I found that the mortality in England between twenty and forty, was about one in eighty."

"It is matter deserving of serious consideration, therefore, how far it is possible to improve still farther the health of seamen. The air at sea is more pure and salubrious than any where else. Nature, therefore, has done much; and, as there is abundant proof of the power of art to controul the causes of disease, there is great encouragement in attempting something further in behalf of the health and lives of this most valuable class of subjects."

"In former times they had not the attention paid to them, which would have been due to inanimate machines of equal utility, ; for there seemed to be much more anxiety about preserving arms from rusting, and cordage from rotting, than about maintaining men in an effective state of health. There was no article in the public instructions issued to naval commanders respecting ventilation and cleanliness till the edition promulgated in 1806."—*Medico-Chirurgical Transactions. vol.* vi.

caused by over-heated ill ventilated berths. The impress tenders, the receiving ships and the transports have also, from their defective ventilation, contributed their full share to these disasters.* In considering also the actual amount of the mortality of our seamen from disease, it appears that it is twice the amount of what it is calculated amongst people of the same age in the other classes of life.

We have not even a full record of the morbid devastation produced among our ships, and many causes conspire to prevent its coming fully before the public. It is not as in the military service, where the sickness of the whole body constitutes one general and impartial document. In the navy it is the individual sickness of each ship; many are consequently interested in concealing the ca-calamity. The surgeon will not proclaim mortality and sickness, which his care might have prevented, or if his intentions have been frustrated by his commander, it would not be prudent for him to give it publicity. He may say, that the wounded, after an engagement, suffer considerably from want of pure air; that they recover more slowly; that the success of operations is more doubtful, and that the ULCER makes its ap-

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* "In transports, we have no doubt, that *contagious fevers often appear* from the causes just mentioned. These vessels are too small, and generally crowded. If bad weather occurs during their passage, or in port, or when they are obliged to live constantly below from falls of rain, diseases of this kind soon make their appearance, and spread by infection. In the tenders employed to collect men from the outports for the navy, whether volunteers or imprest, *this fever is very common.* Receiving ships, on their present establishment, are very liable to foster the powers of contagion, we trace infection more frequently to them than to all other sources."—*Trotter's Medicina Nautica.*

pearance

pearance from the influence of impure air ; but there are various other casualties which he will not venture to record.*

There are, however, no circumstances necessarily connected with a maratime life, to produce this great degree of disease and death. Sailors are certainly exposed to great vicissitudes of temperature, to the injurious impression of cold and moisture, and consequently to the diseases resulting from these causes, but habit renders them less liable than others to the influence of these vicissitudes. A chain also of calamitous events may occasionally, in a more particular manner, endanger the health of a fleet ; but except in such extraordinary cases, prevention is in every respect in our power.

In reviewing our maratime diseases, we always find them connected with the respiration of impure air proceeding from defective ventilation ; it is this agent that has been the chief agent of maratime mortality ; every physician who writes on the diseases of seamen, attributes them to

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* " In the service there is no end to the completion of compliments, even in the most tranquil periods, while fleets are yet stationary, pestilential diseases are frequently prevalent. Hence sums, annually granted, for maratime expenditure, however extensive, have always been found insufficient ; and this has occasioned the bills of credit, for which additional taxes are ultimately requisite. ..... On the resumption of occasional armaments, streets are depopulated by warrants of authority. After short cruizes fleets return with the surviving sick, and, at their next sailing, receive from the same resources a renewal of their complements. Hence no historian, records the bills of *morbid devastation*, and the public only know that a hundred thousand seamen are voted for the current year ; the next brings up the rear, in the total of *extraordinaries*."—*An inquiry into the nature and cause of sickness in ships of war, by William Renwick, Surgeon in the Royal Navy.*

want of ventilation. There is not a physician who writes, that does not proclaim the great neglect of this measure;*—there is not one who does not deplore the consequences of this neglect; the naval expenditure has been greatly increased by its neglect; every feeling of humanity has been outraged by this neglect; our best concerted military enterprises have been frustrated by this neglect. The West India expeditions of old, as well as those of the late war, have been frustrated by the sickness of the men employed; and our expeditions to the continent in former as well as in the *present* times, have been paralized by the same neglect.

"People

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* "The following observations by Dr. Trotter, evince in the fullest manner, how imperfect is the system of ventilation on board our ships of war:—"Many officers are of opinion, that it is advisable to put the men to three watches instead of two, when it can be done, from a supposition, that the greater degree of rest thereby given them, must be conducive to their health, and this would certainly be the case, were they to sleep in a pure air. But as the places where they rest are particularly close and confined, during the night especially, and the air rendered foul by a number of people crowded together, there are those who think it better for them to have shorter portions of rest, by being at two watches, than to continue for eight hours together, sweltering amidst an highly corrupted air."—Surely, nothing can express more strongly the imperfect ventilation of ships than the above quoted passage from an experienced naval medical officer, who considers it better to abridge the natural hours of rest than to permit the men to destroy their health by sleeping in the impure air, below deck.

"The morbid state of his Majesty's fleets in the periods of war, has been found to produce an extensive part of the national debt, together with frequent invasions on the liberty of the subject. The alleviation of such evils is manifestly of the first importance to the general welfare. That all the means adopted for this purpose, have hitherto been very insufficient, the

"People (says Dr. Trotter) will be astonished to see at this period of a triumphant navy, *so many abuses prey upon health*, and that so little desire after improvement should be discovered," and he adds, that "it is a fact sufficiently well established among our maratime people, that the health of our fleets, and troops in transports and in barracks, has risen in proportion to the perfection of their ventilation."

It is therefore of the more importance, that the public should be acquainted with the extent of the evil, as from a variety of circumstances, they are not aware of the injury which results from our omitting to remove those causes which produce this great degree of disease.

When a particular ship under unusual care in her accommodation and internal regulations, and from the selection of seasoned and healthy seamen, has been preserved from disease; and when a long voyage, under these favourable circumstances has been performed, the fact acquires the utmost possible publicity; but the various disasters daily occurring are kept back from the public, who judging only from what they hear, naturally conclude, that disease is in a great measure

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the records of office will amply testify; and the retrospect is pregnant with calamity, as to claim the equal attention of statesmen, and the community at large. To behold thousands of the human race precipitated into situations where they are literally poisoned, is a consideration that will not fail to impress the feelings of those who are either susceptible of humanity, or disposed to regard the vicissitudes of empire. That impression will be greater in the notoriety of circumstances that have been told to departed senates, and may deepen the annals of future detail."—*An inquiry into the nature and causes of sickness in ships of war, by William Renwick, Surgeon in the Royal Navy.*

banished

banished from our fleets, and few naval surgeons in commission, will deem it prudent to undeceive them.

"It is difficult (says Dr. Trotter) to collect much on this important subject, from the scanty materials of the historian, and the medical man is influenced by motives of self-interest, to conceal much of what passes under his observations, and many are unwilling to admit the existence of the evil, least it might be attributed to their neglect. They select only the most prominent topics of discussion.—The skill of the statesman or the general, the bravery of the soldier, the details of the battles which he has gained or which he lost, and the list of the horrible carnage of human beings, resulting from unnatural contests. But he will not detail the gastly spectacles of diseased fleets and armies, prostrated before the ravages—*not of the enemy, but of disease.*

He will not visit the hospital, to detail the appalling spectacle of numbers cut off in the flower and vigour of their youth. He may state in general terms, that an army was forced to retire from sickness, or that the crew of a ship became almost unable to work the vessel from the same cause; but he will not visit the hospital of the soldier, or the sick berth of the seaman; nor will he enumerate the numbers immersed in the unventilated prison of an impress tender, where disease is generated and diffused. In his animadversions on public measures and councils, in his phillipics on the useless expenditure of money, and on the loss of life produced by the sword, he neglects to enumerate disease—so great a portion of the miseries of war is forgotten in the records of nations."

From this very cursory review of the origin and progress of maratime disease, supported as it is by

by the most respectable testimony, and confirmed by such an immense accumulation of facts; it naturally becomes a subject of inquiry, on the part of the public, why proper measures have not been taken to prevent the recurrence of these formidable calamities: alike in opposition as they are to the dictates of policy, and to the common principles of humanity.

The service unfortunately does not hold out sufficient encouragement for professional men of real information and talent, and though occasionally some highly gifted individuals are led from peculiar circumstances to enter into it, few will relinquish the prospect of respect and emolument to be derived from the practice of an honourable and learned profession, for the scanty pay and the subordinate, and in some measure subservient situation of an army or navy surgeon.

When in addition to this, we consider the frightful prevalence of disease and mortality among our soldiers and seamen, and read the numerous, and ineffectual complaints made by medical officers, to remove the causes that gave rise to them, it must be a matter of regret, that a more influential and *positive* authority is not entrusted to the members of the medical profession.

The medical men have not sufficient power in their own department, they are obliged to submit their views to some other less competent tribunal, which is not always adequately qualified to judge of their wisdom and necessity, and which perhaps, disregards or opposes them. Few men, will have the courage to persevere in seeking to carry improvements into effect, in opposition to superior power and influence, and under the impediments of official delay, and perhaps, of official opposition. Wanting that stimulus to exertion, the well earned fame of being the author of useful

improvements

improvements to society, the physician after a few ineffectual efforts for amendment, goes down the stream, which others have gone before, contenting himself with a silent censure of these abuses which proceed from the obstinacy or ignorance of others.

Yet surely there is no reason why the efficient controul of the medical department of the army and navy should be placed under individuals who have no knowledge of medical matters, or why it should be withheld from those who are most competent to direct it, and who as a-body, rank as high in scientific and literary attainments—in moral estimation, and in all those attributes, which command respect and station, as any other class or portion of the community.—— Though the medical officer does not direct our fleets and armies in the day of conquest, he preserves the health of those by whom the victory has been atchieved. He participates also in hardships and privations, and in addition to this, in the silent and unostentatious discharge of those harrassing, responsible and important duties which devolve on him, he is subjected to the danger of contagion, of which he is also the frequent victim.

If the arrangements respecting health and medical establishments be important, they surely should be placed under the *sole* superintendance of the best informed and most competent authority. Were medical men given efficient power in those matters, which came legitimately within the sphere of their jurisdiction, with their due importance in official station, and elevated to a place in the great council of the nation ; their exertions would acquire new vigour and utility from their elevation, our fleets and armies would reap the benefit of unshackled and scientific arrangements,

much

much of that fatal mortality, whose ravages have been hitherto most culpably disregarded, would be prevented, and the public at large in all matters appertaining to health, would enjoy the benefit of learned and enlightened jurisdiction.

Prisons.

All the ill consequences deducible from the respiration of impure air in hospitals, and in all close and crowded places, apply, if possible, in a stronger manner to prisons. The ventilation of these places, is in a peculiar manner defective; the health of the prisoners, has been, and continues to be considerably impaired from this defect, and infectious diseases have arisen in these places, which have spread themselves among our fleets and armies, and which have also diffused themselves through the various walks of civil life. Every feeling therefore of humanity and self-preservation alike, calls for a radical reform in those receptacles of misfortune and of crime.

When a less humane and enlightened superintendance, directed the internal œconomy of our prisons, the annals of our gaols abound with melancholy facts, to prove the activity of human effluvia in generating fever, and also the extreme virulence of the contagious poison, which is thus produced. This country has at different periods suffered severely from the ravages of highly infectious diseases produced in gaols, and subsequently diffused, in consequence of neglect in their cleanliness and ventilation.

Dr. Hales states, that from 50 to 100 died annually in the Savoy Prison, until this mortality was arrested by the adoption of his ventilators,

which were certainly well calculated to free prisons from impure air.

" The most pernicious infection except the plague" (says Lord Bacon) " is the smell of the gaol, where the prisoners are closely and nastily kept, whereof we had in our times experienced twice or thrice, when both the judges who sat upon the gaol, * and numbers who attended their business, sickened and died. Therefore, it were good wisdom, that in such cases the gaol were aired before they were brought forth."†

The earliest instance on record ‡ of an extensive gaol infection, communicated in a court of justice

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* That is, prisoners from the gaol.

† One of the times pointed out by this noble author, was at the fatal assizes held in the year 1577, of which we have a particular account in STOWE's chronicle, in the following words: —On the 4th, 5th, and 6th days of July, were the assizes held at Oxon, where was arraigned and condemned for a seditious tongue; at which time, there arose admidst the people, such a damp, (an old expression for bad air, and still employed by the miners,) that almost all were smothered, very few escaped that were not taken. Here died at Oxon, three hundred persons and sickened there, but died in other places, two hundred and odd."

‡ " At this time, (the 19th and 20th of Elizabeth,) lived in Oxford, a certain book-binder, named Rowland Jencks, who, in his familiar discourse, would not only rail against the commonwealth, but the religion now established, and sincerely by the generality in the University embraced....He made it his chief employment to vilify the government now settled; profane God's word, speak evilly of the ministers....In this course of life, he continued for some time, taking glory, as it were, in it. The university to whom the said person belonged, (because privileged) took cognizance of him and his actions....A convocation of doctors, regents and non-regents being held, May, 1st, it was ordered he should be seized on, and sent to London,

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justice, or at least the earliest authentic account of such an event, may be found in the "History

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to be examined by the chancellor of the university, and the Queen's council, which was done; but, after he had been examined at London, he was sent to Oxford, again to be committed to prison, and stand to a trial the next assizes following, &c. ...The assizes, therefore, being come, which began the 4th of July, and continued two days after, in the court house at the castle yard; the said Jenks was arraigned and condemned in the presence of a great number of people to loose his ears. Judgment being passed, and the prisoner taken away, there arose such an infectious damp, or breath among the people, that many there present, to the apprehensions of most men, were there smothered, and others so deeply infected, that they lived not many hours after. Here Mr. Wood introduced an old ditty upon that event, and printed in black letter, in which death is made to boast of his feats on that occasion. The persons that then died, and who were infected by the said damp, when sentence was passed, were Sir Robert Bell, chief baron of the exchequer; Sir Nicholas Barham, serjeant at law, both stiff enemies to the Roman Catholic religion; Sir Robert Doiley, high sheriff, Hart his under sheriff Sir William Babington, knight, with five justices of the peace, (here follow the names of a considerable number of gentlemen, besides most of the jury, with many others, that died in a day or two after. Above 600 sickened in one night, as a physician (Dr. George Ethryg) that now lived at Oxford, attesteth, and the day after, the infectious air being carried into the next village, sickened there 100 more. The carrying of air to the neighbouring villages, seem to be a mistake, as those who sickened in them, had been exposed to the cause of the disease, In an extract from the register of Merton college, published in the 50th volume of the philosophical transactions, we have these words at p. 701.—Nam *illi solum* et hic et alibi decumbent ægroti, qui in *castro* et *quilda*, quam appellant *aula* quinto et sexto hujus mensis adsunt.)

The 15th, 16th, and 17th days of July, sickened also above 300 persons, and within 12 days space, died an hundred scholars, besides many citizens. The number of persons that died in five weeks space, namely, from the 6th July to the 12th August, (for no longer did this violent infection continue.) were 300 in Oxford, and 200 and odd in other places, so that

and Antiquities of the University of Oxford," by Anthony A. Wood, M. A. of Merton College, first published in English, from the original manuscript, in the Bodleian Library, by John Gutch, A. M. printed at Oxford, in 1796. The *black assize* at Oxford, in July 1577, has been noticed by Bacon, Stowe, Camden and others.* There is another mentioned

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the whole number that died at that time, were 510 persons, of whom many bled till they expired.

The time, without doubt, was very calamitous, and full of sorrow; some leaving their beds, occasioned by the rage of their disease and pain, and would beat their keepers or nurses, and drive them from their presence; others, like madmen, would leap headlong into deep waters.....The physicians fled, not to avoid trouble, which came more and more upon them, but to save themselves and theirs. The doctors and heads of houses, all, almost to a man, fled, and not any college or hall was there, but had some taken away by the infection..... Those who thus died, (he says,) were troubled with a most vehement pain of the head and stomach, vexed with the phrensy, deprived of their understanding, memory, sight, hearing, &c.....That which is most admired is, that no women were taken away by it, or poor people, or such that administered physic, or any that came to visit, but as the physicians were ignorant of the causes, so also of the cures of the disease.....Many supposed, that the cause of this infection proceeded from the nasty and pestilential smell of the prisoners, when they came out of the gaol, of whom, two or three being overcome with it, died a few days before the assizes began, as a note written in these times, testifieth.... ..Some again have thought, and do think, that it was devised by the ROMAN CATHOLICS who used the *art magic* in the design, and that also, as a certain *note* witnesseth, it sprung (he alludes to the register of Merton College, from which he copies the following extract,) ex artificionis *Diobolicis*, et plane *papisticis* flatibus e *Lovaniensi* barathro excitatis, et ad nos scelestissime, et elam emissis."—*The history and antiquities of Oxford, by A. Wood, vol. 2, p. 188, c. 24.*

* "Camden, in his annals, Reginæ Elizabeth, 1577, after mentioning the bringing up of Jencks for judgment, adds, "venenoso

mentioned by Hollingshed, at Exeter, during the assizes

" venenoso et pestilenti halitu, sive fædore incarceratorum, sive ex solo ita correpti sunt, plerique omnes qui aderant," &c.

Sir Richard Baker, in his chronicle of the Kings of England, after mentioning the same proceedings against Jenks, adds, " The court were surprized with a pestilent savour, whether rising from the noisome smell of the prisoners, or from the damp of the ground, is uncertain; but all that were present, within 40 hours died, except women and children, and the contagion went no farther. Their died *Robert Bell*, Lord Chief Baron, *Robert D'oylie*, *Sir William Babington Doyle*, Sheriff of Oxfordshire, *Harcourt*, *Weyman and Fettiplace*, the most of them in this tract, *Barham* the famous lawyer, almost all the jurors, and 390 others more or less.

From Dr. Meade, we have the following account of the event, as well as his opinion of the cause.—" In our common prisons, many have what they call the GOAL FEVER, which is always attended with a degree of malignity, in proportion to the closeness and stench of the place; and it would certainly very well become the wisdom of the government, as well with regard to the health of the town, as in compassion to the prisoners, to take care, that all houses of confinement, should be kept as airy and clean, as is consistent with the use to which they are designed.—The BLACK ASSIZES at Oxford, held in the castle there, in the year 1577, will never be forgot: in which the judges, gentry, and almost all that were present, to the number of three hundred, were killed by a poisonous steam, thought by some to have broken forth from the earth, but by a noble and great philosopher, (Lord Bacon) more justly, supposed to have been brought by the prisoners out of the gaol into the court, it being observed, that they alone were not injured by it."—*Mead's works.*

The following translated extract, from a latin letter, refers to the same event, has been preserved in the life of Bernard Gilpin, by William Gilpin, M. A. 2nd edition, London, 1763, p. 120.—" Those who are seized with it, (namely, the disease specified by Wood in loc. citalt.) are in the utmost torment;

assizes there in March, 1586.*

We have no subsequent instance recorded of any remarkable calamity proceeding from gaol sickness, until

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ment; their bowels are burnt up; they call earnestly for drink; they cannot bear the touch of clothes; they intreat the standers by, to throw cold water upon them; sometimes they are quite mad, rise upon their keepers, run naked out of houses, and often endeavour to put an end to their lives. The physicians are confounded, declaring they have met with nothing similar, either in their reading or practice. Yet, many of them, give this distemper a name, though they have done nothing, to shew that they are at all acquainted with its nature. The greater part of them, I am told, have now left the town, either out of fear for themselves, or conscious that they can do no good. This dreadful distemper, is now generally attributed to some gaol infection, brought into court at the assizes, for it is remarkable, that the first infected, were those only who had been there. Few women or old men have died. God be thanked, the rage of this pestilence is now much abated. It is still among us, in some degree, but its effects appear every day weaker."—*Extract from a letter written from the University of Oxford, by a college tutor to Bernard Gilpin, and preserved in the life of Bernard Gilpin, written by William Gilpin.*

* "At the assizes kept at the citie of Exeter, the 14th daie of March, 1586, in the eight and twentieth year of her majesties reigne, before Sir Edmund Anderson, knight, lord chief justice of the common pleas, and Sergeant Floredaie, one of the barons of the exchequer, justice of the assize in the counties of Devon and Exon, there happened a very sudden and strange sickness, first among the prisoners in the gaol of the castle of Exon, and then dispersed (upon their triall) amongst sundrie other persons. This sickness was very sharp for the time, and few escaped, which at the first were infected therewith. It was contagious and infectious, but not so violent as commonlie the pestilence is; neither doth there appear any outward *bleer* or *sore*.....The origin and cause thereof, diverse men are of diverse judgments. Some did impute it, and were of the mind, that it proceeded from the contagion of a gaol, which by reason of the close aire and filthie stinke, the prisoners newly come out of a fresh air, into the same,

until 1730, when at the Lent Assizes, some prisoners, who had been removed from *Ilchester* gaol to take their trials at *Taunton*, were believed to have infected a part of the court, and produced a contagious disease, of which the Chief Baron Pengally, with some of his officers and servants, and Sir James Shepard, knt. and serjeant at law died afterwards at Blanford, in Dorsetshire. John Pigot, Esq.

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same, are in a short time, for the most part, infected therewith, and this is commonly called *gaole sickness*, and MANY DIE THEREOF. He then proceeds to relate the case of thirty-eight Portuguese seamen, who had been, for some time before, taken at sea, coming with fish from Newfoundland, and cast into the *deep pit and stinking dungeon* of the gaole of the castle of Exon, and had no change of apparal, but being left to lie upon the ground, without succour or relief, were soon infected, and all, for the most part, were sick, and some of them died, and some of them was (were) distracted, and this sickness very soon after dispersed itselfe among all the residue of the prisoners in the gaole, of which disease, many of them died, but all brought to great extremities, and verie hardlie escaped. These men, when they were brought before the foresaid justices for their triall, manie of them were so weak and sicke, that they were not able to go nor stand, but were carried from the gaole to the place of judgment, some upon hand barrows, and some between men leading them. He adds, that these miserable men were brought in at one end of the hall, near to the judges seat; where their wretched condition excited general commisseration, and particularly that of the chief justice, who, upon this occasion *tooke a better order*, for keeping all prisoners thenceforth in the gaole.....and howsoever the matter fell out, and by what occasion it happened, an infection followed upon manie, and a great number of such as were there in the court, and especially such as were nearest to them, were soonest infected. And albeit the infection was not then perceived, because every man departed, as he thought, in as good health as he came thither; yet, the same, by little and little, so crept into such, upon whom the infection was seizoned, that after a few daies, and at their homecoming to their houses, they felt the violence of this pestilent sickness, wherein more died, that were infected, than

Esq. high sheriff of Somersetshire, also died as was supposed, of the same disease, which spread considerably at Taunton, and proved fatal to several hundreds.*

Twelve years afterwards, viz. in April, 1742, according to Dr. Huxham, (de Aere, vol. ii. p. 82.) a fever which he calls putrid contagious, highly pestilential, (febris putrida, contagiosa, ac pestifera valde,) appeared at and in the neighbourhood of Launceston, occasioning great mortality there. This fever he adds, was generated in the prisons, and widely disseminated by means of the county assize, (genita hæc in carceribus febris et per comitia provincialia disseminata longe laté que,) At page 83 of the same volume, Dr. Huxham adds, "Perfrequens est utique generatio febris pestilentis in angustis immundisque carceribus; etiam ipse aer conclusus in fodinis, speluncis, puteis, tandem evadit exitialis admodum idque longe citius, si accedunt quoque plurima animalium effluvia, quæ et ipsa porro magis magisque in horas violenta fiunt, brevi que pestifera maximé. Here he refers to Lancisi, de repentinis mortibus, L. 1. C. 6. Atmosphæra stagnans, frequentia hominum polluta

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than escaped. He then gives the names of some of the principal persons who were thus cut off, among whom were sergeant Floridaie, one of the judges, three knights, and several esquires and justices of the peace, and many constables, reeves, tything men, &c. In this case, the disease appears to have been propagated by those who were first attacked, so, that it was dispersed throughout all the whole shire."—*Hollingshed's chronicles.*

* "In April, 1730, lord chief baron *Pengelly*, with several of his officers and servants, and Sir *James Shephard*, knt. sergeant at law, dying at *Blandford* in *Dorsetshire*, on the western circuit, during the lent assizes, as also *John Pigot*, esq. high-

polluta, mox valdé rancet et ad respiratinem inepta est prorsus, imo aquæ dulcis balneum sorde cutanea fædatum putrescit atque putet brevissimé. Nec mirum est hoc utique quandoquidem a quolibet adulto homine unciæ 40 fere rancidi vaporis quotidie exhalant."

The next remarkable occurrence of this sort, happened at the sessions of the Old Baily, in the spring of 1750,* which proved fatal to the Lord Mayor and two of the judges, with several eminent and other persons, who were infected by the contagion of the gaol, brought into the court

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high-sheriff of *Somersetshire;* it was supposed to proceed from the stench of some prisoners brought from *Ilchester* goal to their trials at *Taunton*, in which town the infection afterwards spread *and carried off some hundreds.*"—*Gentleman's Magazine, for* 1750.

* "In the year 1750, on the 11th of May, the sessions began at the Old Baily, and continued for some days, in which time, there were more criminals tried, and a greater multitude was present in the court, than usual. The hall in the Old Baily, was a room of only about 30 feet square. Now, whether the air was most tainted from the bar, by some of the prisoners, then ill of the gaol distemper; or by the general uncleanliness of such persons, is uncertain, but it is probable, that both causes concurred. And we may easily conceive, how much the air might have been vitiated by the foul steams of the bail dock, and of the two rooms opening into the court, in which the prisoners were the whole day crowded together, till they were brought out to be tried. I have been informed, that at those sessions, about a hundred were tried, who were all kept in close places, as long as the court sat. In which, during the trials, were put some of the malefactors who had been under the closest confinement. It appeared afterwards, that those places had not been cleaned for some years. The poisonous quality of the air, was aggravated by the heat and closeness of the court, and by the pespirable matter of a number of people of all sorts, penned up for the most part

from Newgate. It was in consequence of this, and immediately after, that Sir John Pringle published his observations on the nature and cause of hospital and gaol fever.

In Dr. Hales's work on ventilation, we have a great variety of information respecting Newgate and prisons in general ; from him, it appears, that in the Savoy, and other gaols, the occurrence of fever to a considerable extent, took place almost every year, and that this disease was prevented by the introduction of his ventilators. Howard also, at

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part of the day, without breathing the fresh air, or receiving any refreshment. The bench consisted of six persons, whereof four died, together with two or three of the counsel, one of the under sheriffs, several of the Middlesex jury, and others present, to the amount of forty, without making allowance for those of a lower rank, whose death may not have been heard of, and without including any that did not sicken within a fortnight after the sessions."—*Sir John Pringle on the gaol fever.*

" At the old Baily sessions in 1750, one Mr. Clarke was brought to his trial, and it being a case of great expectation, the Court, and all the passages to it, were extremely crowded.——Many people, who were in court at this time, were sensibly affected with a very noisome smell ; and it appeared soon afterwards, upon an inquiry ordered by the court of aldermen, that the whole prison of Newgate, and all the passages leading thence into the court, were in a very filthy condition, and had long been so. What made these circumstances to be at all attended to, was. that within a week or ten days at most, after the sessions, many persons who were present at Mr. Clark's trial, were seized with a fever of the malignant kind ; and few who were seized recovered.

The symptoms were much alike in all the patients ; and in less than six weeks time, the distemper entirely ceased. It ought to be remembered, that at the time this disaster happened, there was no sickness in the gaol more than is common in such places ; this circumstance, which distinguisheth this from most of the cases of the like kind, which we have heard of, suggested

at this period, was the means of producing some partial reformation, but the prisons yet remain a reproach to the city. The following statement on this subject, is taken from Mr. Bennet, who is on all occasions, the zealous opposer of every abuse, and the advocate of every enlightened and liberal principle.—

" This subject, (the abuses of Newgate,) to the discredit of the city of London, is not new; it is not now agitated for the first time." In 1783, Mr. Howard * referring to Old Newgate, says, " that

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gested a very proper caution,—*Not to presume too far upon the health of the gaol, barely because the gaol fever is not among the prisoners.*——*Foster's Reports and Cases on Crown-law, fol. Oxford,* 1762, *p.* 72.

" As the most putrid vapours, are the most subtile and volatile, so I observed them to be in the court of the Old Baily, May 11th, 1750, when I was obliged to be there? (the Rev. Dr. Hales attended as a witness to Captain Clarke's character upon the trial in question,) and found that the smell of the air in the gallery, on the right side of the court, sensibly more offensive than below, when I was called down among the crowd to give evidence. And accordingly, those who were situated highest in the court, as the Lord Mayor, judges, *Middlesex* jury, and those in the gallery on the left hand side of the court, were chiefly infected with the fatal contagion; on which side a wide sash window, facing the judges was open; at which an easterly wind entered, which blew down the most venemous vapour which was near the cieling, and condensed in some degree, and checked the subtile infectious vapour, heated by a crowded court for many hours, from ascending so fast from among those on the bench, and in the left-hand gallery; whereas in the right-hand, where no window was open, the same heat might cause the envenomed vapour to ascend quicker to the lofty cieling; as it is well known, such vapours constantly do in rooms full of crowded assemblies.—*Hales on Ventilation, part* 2.

* " There are prisons, into which whoever looks, will at first sight be convinced, that there is some great error in the manage-

the builders seemed to have regarded in their plan nothing but the single article of keeping the prisoners in safe custody. The rooms and cells were so close, as almost always to be the constant seats of disease.*** I am of opinion, that without more than ordinary care, the prisoners in it will be in great danger of the goal fever." In the second volume of his works, which gives an account of Newgate in 1787, he remarks, "that there was no *alteration* since his former publication."*** In September, 1808, Sir Richard Philips, one of our Sheriffs, addressed a letter to the Livery of London, on the condition of the different prisons under his control. In his observations on Newgate, he complains, (as existing then,) of all the defects a prison can possess, want of room, *air*, food, &c.

"To convey a just idea of these yards (says he) in which the prisoners live and lodge, the most apt com-

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management of them. Their sallow, meagre countenances declare, without words, that they are very miserable:...Many, who went in healthy, were in a few months changed to emaciated, dejected objects: some are seen pining under diseases, sick and in prison, expiring on the floors in loathsome cells, of pestilential fevers....Air, which has been breathed, is made poisonous in a more intense degree by the effluvia from the sick and what else in prison is offensive. My reader will judge of its malignity, when I assure him, that my clothes were in my first journey so offensive, that in a post chaise, I could not bear the windows drawn up, and was therefore obliged to travel commonly on horseback. The leaves of my memorandum book were often so tainted, that I could not use it 'till after spreading it an hour or two before the fire. From hence one may judge of the probability there is, against the health and life of prisoners crowded in close rooms, cells, subterraneous dungeons, for fourteen or fifteen hours out of the twenty-four. .. From my own observations, I was fully convinced, that many more prisoners were destroyed by the *gaol fever*, than were put to death by all the public executions in the kingdom."—*Howard on Prisons.*

parison

parison is the engraved representation of a slave ship, which a few years ago was circulated through England, with much effect. When the prisoners lie down on their floors by night, there must necessarily at least, in the womens wards, be the same bodily contact, the same arrangement of heads and legs, as are represented in that drawing of the deck of a slave ship. The wards being only 43 feet wide, admit by night of two rows to lie down at once, in a length of 37 feet, that is to say, twenty-five or thirty women, as it may be, in a row, having each a breath of 18 inches by her length.—At times, the women have lain in the space afforded by the difference between the breath of the room and the length of two women."

Here then is a prison, the mismanagement of which has been for years notorious, published, proclaimed, reported against, by the proper officers, and yet there is no real reform, *** the main evils of want of food, *air*, clothing, &c. remain."*

The grand jury of Middlesex, having presented the deplorable condition of Newgate, a copy of which presentment was moved for in the House of Commons, by Mr. Eden, a committee was appointed to inquire into the state of the prisons, &c.

In 1815, Mr. Bennet moved for a committee to examine into the state of the Fleet, King's Bench, Marshalsea and Newgate prisons.

Mr. Bennet says, that the schools were filled with bad air "that the children had all the appearance of bad health; they were dirty, ragged and wretched, and the rooms close and offensive."

The next statement of the condition of Newgate is to be found in the second police report of the session of 1817.

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* Letter to the Common Council and Livery of the City of London, on the abuses existing in Newgate, by the Hon. H. G. Bennett, M. P.

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In the session of 1818*, a committee of the house of commons, received a variety of evidence respecting the condition of the city prisons, and obtained some important disclosures respecting their health. Mr. Box, the surgeon, says, that upwards of 400 cases of fever, including relapses, occurred

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* An abstract of the number of cases attended in the different prisons, according to the dates specified in the statement :—

Total number of cases of fever admitted into the male infirmary of Newgate, from the 16th of May 1817 to the 1st of January, 1818, ...	248
Number of relapses during that period, ...	126
Cases of fever, admitted into the female infirmary in the same period, ...	32
Other diseases, ...	69
In Giltspur-street prison, ...	589
Borough Compter, ...	150
	1,250

Besides these admitted into Newgate Infirmary, there are about 18 out patients a day.

Mr. Box, says, the relapses are frequent, from bad air. These removed from other prisons into Newgate, are in general in an indifferent and weak state of health, appearing a good deal emaciated.—One of the great causes of increase of fever in Newgate, has been, the Middlesex magistrates committing immediately to Newgate, people in ill health.

" Having separate sleeping rooms, has certainly done more harm than good, under the present regulation, there being a large number in each ward, and having a fire each day, they get warm, and get their skins into a state of pespiration, then they are immediately removed at night into a cold room, which has had no fire in it all day, where their breaths have condensed on the bed clothes, so that they actually go into damp beds at night. Question by a Member, Do you think it would be a very convenient mode of remedying that, by lighting fires in their bed rooms? A fire might be put there, or a brazier might be carried from one ward to another in the course of the day, or they might hang out the bed clothes to dry,; but it does not appear to me, there exists sufficient ventilation in the bed rooms ; the

occurred in less than one year, and that relapses are frequent and dangerous, proceeding from the bad air of the prison.

The happy zeal which some good and truly enlightened persons, have lately evinced, for the proper classification and moral improvement of prisoners, has incidently brought before the public, in a fuller and more detailed form, the wretched health of these abodes of human suffering, proceeding from damp and bad air. Mr. Buxton,* who has distinguished himself in parliament,

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the bed rooms are not conducive to the health of the prisoners. .....Mr. Cotton the ordinary, was alarmed at the fever, and Mr. Box did not see him attend the men's infirmary.....

In Giltspur-street compter, and the house of correction, average number of sick requiring confinement in the infirmaries, is above 8 per day.—In last January twelve months, 180 were sick, many brought in, in a deplorable state of health—the prisoners complain of damp in the cells; they are very damp in winter.....Unhealthy consequences would ensue, from putting a person in a weak state of health into those cells .....they complain much of cold in them.....the construction of the cells and day room obstruct the free circulation of air.....The borough compter has been very unhealthy.....they have had occasionally fever."—*Minutes of evidence before the select committee of the House of Commons, by Mr. Box, Medical Attendant to the London Prisons.*

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* THE BOROUGH COMPTER.

"You next enter a yard nineteen feet square: this is the only airing place for male debtors and vagrants. Female debtors, prostitutes, misdemeanants and criminals, and for their children and friends. There have been as many as thirty women; we saw thirty-eight debtors, and Mr. Law, the governor, stated when he was examined, that there might be about twenty children.

On my first visit, the debtors were all collected together up stairs. This was their day room, bed room, work-shop, kitchen, and chapel. On my second visit, they spent the day and night in the room below; as the third, both the rooms above and that below were filled.

The

ament, by one of the most able speeches ever made

The length of each of these rooms, exclusive of a recess, in which were tables and the fire place, is twenty feet.——Its breath is three feet six inches for a passage, and six feet for the bed. In this space, twenty feet long and six wide, upon eight straw beds, with sixteen rugs, and a piece of timber for a bolster, twenty prisoners had slept side by side the preceding night: I maintained, that it was physically impossible, but the prisoners explained away the difficulty, by saying, "they slept edgeways." Amongst these twenty, was one in a very deplorable condition; he was taken from a sick bed and brought there; he had his mattrass to himself, for none would share it, and indeed my senses convinced me that sleeping near him, must be sufficiently offensive.

I was struck with the appearance of one man, who seemed much distressed: he had seen better times, and was distressed to be placed in such a situation. He said he had slept next to the wall, and was literally unable to move, from the pressure. In the morning, the stench and heat were so oppressive, that he and every one else on waking, rushed unclothed, as they must be, into the yard, and the turnkey told me, "*That the smell on the first opening of the door, was enough to turn the stomach of a horse.*"

I cannot reflect on the scene which I witnessed, without grief: *almost every man looked ill, and almost every one who had been there any time said, he had had a severe illness; we were all immediately struck with their squalid appearance.* It may perhaps, be supposed, that we were duped by our imaginations, that observing the closeness and want of exercise to which they were subjected, and ascribing to these causes their usual effects, we concluded without sufficient examination, that the prisoners must be unhealthy. The following fact, for the accuracy of which, I appeal to my respectable companions, will evince that I describe, not merely, what I expected to see, but what we actually saw. I called my friends together, and requested their attention: I then addressed myself to one of the prisoners at another part of the room, to whom we had not previously spoken, and said, I perceive by your appearance, you have not been here long? only nine days, was his answer. To another, you have been here very long I should suppose? nearly nine months. In fact, I pointed out five, and from their looks, predicted nearly the period of their confinement, nor was I once deceived.

made in that house, on the reformation of our
X criminal

I have seen many hospitals and infirmaries, but never one to the best of my belief, in which the patients exhibited so much ill health. The following facts deserve attention, on my second visit, there were thirteen persons confined on criminal charges, of whom, *five were under the surgeon's hands, as cases of fever.* On my first visit, we observed in one of the cells, a lad in bed, seemingly very ill with fever; the window was closed, and the reason given, was, that the air would be dangerous to him, yet the preceding night, two other prisoners had slept with him, in a room, seven feet by nine.—The three were:——

James M'Intosh, charged with felony.
Thomas Williams, —— with stealing a piece of gingham.
Jeremiah Noble, —— with an assault. (*a*)

And no alteration was intended, neither indeed was any possible.

We conceived, that to place persons for the night, in this corrupted and infected air, close by the source of that infection, was inevitably to taint them with disease. This conjecture was unhappily verified, for at my next coming, I observed in the list of those who had been seized with fever, the names of Thomas Williams and Jeremiah Noble. Now mark the case of Jeremiah Noble; he is charged with an assault, and the law condemns him to a short imprisonment preparatory to his trial; but the regulations of the city, inflict on him, in addition, a disease very dangerous in its nature, very suffering in its progress, and very enfeebling in its consequences. The vigour of his constitution may surmount it, but all prisoners may not have vigorous constitutions; thus, the most venial offence, which calls down the visitation of the law, a debt of one shilling, or a fraud to the amount of one penny, may be punished with a lingering and painful death.

"The following minutes are extracted from the surgeon's books:—

December 10th, M'Intosh has a feverish complaint.
— 14th, M'Intosh better, the other prisoners healthy.
— 27th, Williams, Noble, and Rawlins are ill.
— 30th, The above are attacked with fever.

M'Intosh is declared to be ill of fever on the 10th instant, and on the 16th, I find that Williams and Noble had slept with him the preceding night. On the 27th, they also are seized with

criminal code, has published a work on prison dis-

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with fever. If the reader will pay attention to these dates, I think he will concur with me in the conclusion I have formed, viz. that Williams and Noble derived their disorder from sleeping with M'Intosh."

Now, it is evident, that the regulations of this prison are calculated to produce, and to communicate disease.—The next question is, what measures are taken to cure it? Till very lately, there was no surgeon or apothecary provided, nor any medicine allowed. There is no infirmary. But one of the female apartments is used as such, when the prison is comparatively empty. When a debtor is ill, he is separated from the others by a blanket, but how effectual that separation must be, which takes place in a room of 20 feet in length, and in which 20 persons sleep side by side, will require no particular sagacity to determine. When a criminal is ill, however infectious may be his complaint, however offensive, however requiring quiet, there is generally no separation at all. I observed in the surgeon's book, a multitude of judicious observations, as to the unwholesomeness of the prison, amongst the rest, the following :—

October 7, 1817.

"The prison is clean, but from its crowded state, there are seven requiring medical attendance, if fever ensue in consequence, the greatest danger is to be apprehended, from a total want of accommodation to separate the sick.

Signed, W. H. Box.

The case of one man struck me much, I saw him lying on a straw bed, as I believed at the point of death, without a shirt, inconceivably dirty, so weak, as to be almost unable to articulate, and so offensive, as to render remaining a minute with him, quite intolerable ; close by his side, five other untried prisoners, had slept the preceding night, inhaling the stench from this mass of putrefaction, hearing his groans, breathing the steam from his corrupted lungs, and covered with myriads of lice from his rags of clothing ; of these his wretched companions, three were subsequently, by the verdict of a jury, pronounced not guilty, and of these, one was Noble, whose case I have before described.

"Thus this prison, within less than five minutes walk of London-bridge ; a prison which outrages every feeling of common humanity, which is really very shocking, melancholy and disgraceful

discipline, which has afforded a very full state-

ment

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disgraceful—*a prison in which the period of each man's captivity may be judged by the degree of languor and sickliness visible in his countenance*—a prison, the regulations of which, openly violate the laws of the land, and are the direct reverse of the rules recommended by the committee of aldermen—a prison, in which I have witnessed as much of what is truly deplorable and dismal, as it ever was my misfortune to behold; in which, it is difficult to determine, whether the vice it encourages, is, or is not surpassed by the measure of misery it inflicts.—This prison has not as far as appears, been visited by one single official person, capable of redressing the slightest of its atrocious evils, for a period of more than six months."

TOTHILL FIELDS.

Many of the wards, in which the prisoners sleep, are sunk below the level of the ground, and this level is considered to be below high water mark. The prisoners complained bitterly of the cold and moisture of these cells. To obviate these inconveniencies, as many as possible, crowd together at night, into the same cell; how injurious this must be to health, can be conceived by the statement of the gaoler, who told me, *that having occasion lately, to open one of the doors in the night, the effluvia was almost intolerable.* My readers will naturally ask, what is the result *of these precautions against health?* I will answer by facts.—We saw a woman lying in one of the wards, who seemed very ill. The apothecary happened to come in at this moment; upon examing her, he said to the keeper, SHE IS ILL JUST LIKE THE REST.—The proportion of sick, varies from six to ten in the hundred, and about two thousand pass annually through the prison.

ABBEY OF ST. ALBANS.

House of Correction.

The room in which they pass the day, cook their victuals, and sleep at night, was very close, and emitted a very offensive smell. *It is however capable of ventilation.* The sewer is in a closet in the same room. The bed consisted of straw, on the floor, with four blankets and two rugs for five men—one of them looked exceedingly ill.

GUILFORD.

There is no infirmary, and no possibility of separating the healthy from the sick. They must sleep together, and the

rooms

ment of the total disregard to health, usually evinced

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rooms must be crowded. *Low fever was very prevalent in the autumn; there were as many as six cases at a time. Had the disorder been very contagious, the consequences in the governor's opinion, must have been dreadful.*.....There is no privy, the consequences of all this is, that the prisoners are dirty to an extreme, are very abject and sallow in their appearance, they have generally severe colds and rheumatism, and if the governor is to be credited, they leave the prison worse in every respect, than when they entered it.....The moment a prisoner arrives, he is turned in among the rest, however filthy or diseased he may be.....Let it never be forgotten, that of these poor creatures, some are vagrants, often Irish labourers, who have fled from starvation at home, and wandered into England in search of employment, guilty of begging to sustain life; some are convicted of the most trifling offences, and many are untried, that is, after having spent a night wedged in with this mass of uncleanliness, they may be proved, on the morrow, as innocent of the imputed crime, as the judge who tries them.

Is this justice? Is it humanity? We live in a free country, and we boast that the rights of the meanest men amongst us, are as inviolable as those of the greatest; we are followers of christianity, which teaches us, that we should do unto others, as we would, that others would do unto us; but we must renounce our pretensions to the one, and abdicate the principles of the other, or we must correct these high and grievous abuses.....I feel, I have failed in doing justice to the appearance of the prisoners. Misery was displayed more evidently in their dress, and written in more legible characters on their countenances, than in any gaol I ever entered.

At the HOUSE OF CORRECTION at CHELMSFORD, I was advised by the gaoler not to enter, *as sickness was very prevalent*, it appeared, that one youth had died in the morning of small-pox, and one was (as it was supposed,) dying of the typhus fever.—The county gaol at KINGSTON, is, in most respects, a counterpart to that of Guildford.....At HORSEMONGER-LANE house of correction, the cells are about six feet by eight; sometimes as many as five, and constantly three are placed within them for the night.

BRISTOL GAOL.

We first entered the yard appointed for criminals; it is an irregular

evinced in those places; and more recently, Mr. Gurney

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irregular space, about twenty feet long, and twelve wide, and was literally so crowded, with its sixty three inhabitants, as to occasion some difficulty in passing through it.....After seeing this yard, and another of larger dimensions, the adjacent day rooms, and sleeping cells, the conclusion of my own mind, was, that nothing could be more offensive or melancholy. This opinion was, however, speedily refuted, a door was unlocked, we were furnished with candles, and we descended eighteen long steps into a vault, at the bottom, was a circular space—a narrow passage, eighteen inches wide, runs through this, and the sides are furnished with barrack bedsteads. The floor, which is considered to be on the same level with the river, is very damp. The smell, at this hour, one o'clock, was something more than can be expressed, by the term "disgusting." The bedstead was very dirty, and on one part of it, I discovered a wretched being, who complained of severe illness. This was his infirmary—the spot chosen for the restoration of decayed health—a place, one short visit to which, affected me with a nausea, which I did not recover for two days. The preceding night, eighteen persons had slept here; and according to the report of the turnkey, some of these untried. My readers, will wish to know, how this pit is ventilated. There is a kind of chimney, which had been closed up, it is said, by the prisoners, and never opened in the recollection of the turnkey. There is, also, a door at the top of the stairs, which is closed day and night. It is then a dungeon, in its worst sense—a dark, cheerless, damp, and unwholesome cavern, never refreshed by a breeze of pure air, or a beam of sun shine.

Mankind have hitherto been disposed to believe, that pure air is one of the requisites for good health. This prevalent doctrine, must, however, be ranked among the delusions of the medical art, or the gaol at Bristol, must impair the health of every person who comes within it. Whoever is brought thither, charged with an offence, be that offence great or trivial, be that charge true or false, he must, at all events, suffer a tremendous punishment; he must live in contact with the utmost filth, converse, or at least, associate with the utmost guilt, and breathe an atmosphere, corrupt to a degree, which renders description impossible, and if it were possible, too indelicate and nasty for the public ear.

Reason

Gurney has visited some of the prisons in Scotland

Reason alone, will teach any man, that the confinement of so many persons in so narrow and unwholesome a place, is to generate disease ; but unhappily no effort of reason is necessary, a walk through this gaol will place this matter beyond controversy. The countenances of all those, who have been here any length of time, present a testimony, wretchedly conclusive. Seeing their deplorable looks, I enquired as to their health. All to whom I spoke, complained of continual illness. One had been there for 31 months, and according to his own account, never well. Another 14 months, and never well—and how (they very fairly asked) could it be otherwise, when we are giddy and sick every morning, from the air in which we have passed the night. This they said in the presence of the turnkey, who gave his tacit consent to it, only adding an observation, precisely similar to that recorded by Mr. Neild, as made to him, when visiting this gaol, seventeen years ago. He says, the turnkey himself, told me, that in a morning when he unlocked the door, he was so affected with the putrid steam issuing from the dungeon, that it was enough to knock him down.....Of all its wretched departments, the room, in which the females reside day and night, was perhaps the most disgusting. Even the pit itself, emitted a smell hardly more painful, than this abode of the women and their sickly children. Stern severity may deny compassion to guilt ; severity more stern, and far more inequitable, may withold it in cases of suspected guilt ; but I trust, we live in a country, where no one can behold, without some feelings of sorrowful compunction, infancy exposed to such air, and to such severity.

There is no female infirmary ; if a woman be taken ill, (and illness ought certainly to be contemplated as possible in such an atmosphere) with any complaints, infectious or otherwise, she must remain in the ward, with whatever danger to herself, with whatever danger to her companions.**** To conclude, when I say, that it is almost impossible for any prison to be worse calculated for the preservation of health, for the prevention of contagious disorders, or for the eradication of such diseases, when once they have arisen —When I say, that the felons are crowded together by night to such a degree as to excite surprise, that they should escape suffocation,—and that there reigns throughout the whole edifice, a chilly damp, unwholesome

land and the North of England, in company with Mrs. Elizabeth Fry, and has afforded some valuable

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wholesome atmosphere, which cannot but be pernicious to all its inmates, and dangerous to those who are obliged occasionally to visit it.—I speak indeed my own sentiments, but in the language of the four principal physicians of Bristol, who visited the prisons in 1815.

There is a kind of atmosphere of stench round every prisoner; his clothes are so painted with it, that the clergyman told me he found it necessary to take his seat in the chapel before the prisoners were admitted, othewise the effluvia to a person coming at once from the open air, would be so powerful as to disable him from the discharge of his duty.*** Such was the state of the Bristol gaol, when I visited it, but those who would form a proper estimate of it, must remember, that I saw it under every advantage. * * * I saw the Pit when the prisoners were excluded from it—what must it be, when they are crowded together within it.—I saw it in the middle of a cold March day, what must it be in a sultry Summer's night?

It is a matter of regret, that many with feeling hearts know little of grief, but from the representation of poets and novelists. It is time that this unprofitable waste of tenderness should cease, that the sensibility of the public should be directed from fictions to reality. Scenes calculated to provoke the most lively compassion, are to be found even in England—perhaps, no where more than in the gaols. That at Bristol calls loudly for benevolent interference.—Some time must, a considerable time may elapse, before the new prison is fitted up for the reception of prisoners. In the interim, some hundreds, perhaps thousands of human beings, may there be tainted with disease, or corrupted by viscious communications, **** even three years continuance of so destructive an inroad on health and morals, is an evil of vast importance. How many persons may it destroy? surely no time ought to be lost, and no sacrifice ought to be denied, which may terminate the evils of a prison, which condemned by Howard, and reprobated by Neild, is worse at this moment, than it was when they visited it.

Newgate.

In Newgate, the number of prisoners from May 16th, 1817, to January 1, 1818—was 1500,— of these 511 were admitted to the Infirmary as seriously ill; besides which, several were excluded for want of accommodation, and many whose indisposition

luable information respecting them, in a pamphlet entitled, "Notes on Prisons."*—The reader who will

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position was too slight to require confinement, of the latter description, *there were daily about* 18 *cases*. Upon these data, we may fairly compute, that considerably above one-third of the prisoners suffer more or less from disease.—*Buxton on Prison Discipline, 2d ed.* 1818.

(*a*) Mr. Box, in his evidence before the select committee of the house of commons, denies that these men were infected by M'Intosh, and it appears also, that when they were infected, he recommended their removal. The situation of a medical attendant to prisons in general, is attended with great difficulties ; he must make the best of the circumstances in which he is placed, and those to whom their regulation is entrusted, are not always inclined to attend to the suggestions of the men most competent to offer them advice. It too frequently happens, that those who fill public offices, suppose, that knowledge is a necessary attendant on office. In the course of the author's enquiries respecting ventilation, he often has had to regret, the want of efficient power in the medical attendants of our public establishments. It is but justice to Mr. Box, to say, that were it not for his most assiduous and judicious attention, Newgate, must have been, this time past, a perpetual hot bed of contagion.

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*The following extracts are taken from notes on a visit made to some of the prisons in Scotland and the North of England, in company with Elizabeth Fry by Joseph John Gurney.—

DONCASTER GAOL.

Fifteen persons have at times been locked up for the night in a room, measuring only thirteeen feet square—the state of these poor wretches, when thus situated, must have been in a very high degree, miserable and unhealthy. In the male vagrants room, there is no light when the door is shut, except through a hole in the door and of course no ventilation.

YORK CASTLE.—The COUNTY GAOL.

The day room measures twenty-four feet by fifteen.—The turnkey remembers, when there were eighty felons confined in it.—The night cells connected with this part of the prison are ill ventilated—three or four of them *are totally dark, and admit no external air*—the men exhibit a most squalid appearance.

DURHAM

will take the trouble of perusing these different statements, of the actual condition of our prisons,

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DURHAM OLD GAOL, House of Correction.

You descend from the felons day-room, and from the day light, by thirty steps, to the sleeping cells which are perfectly dark, and without any ventilation, except from a hole in the cieling—the House of Correction is built against a steep bank, close by the river. The unfortunate persons who are confined in this prison, are obliged to pass the night in a damp and most dismal vault, measuring nineteen feet and a half by fourteen, and built immediately above the level of the river, but thirty-three steps below the street, from which you enter the prison. This dungeon is entirely without light, nor does it admit any air except from the passage which leads to it. Fifteen persons have at times been locked up in it together.

NEW CASTLE UPON TYNE, Town and County Gaol.

The manner in which they are confined, is extremely objectionable, having no access to the yard, nor any sleeping cells, they pass both day and night in their small day-rooms, fourteen feet square, without change or intermission. Six persons have been confined for several months together, in one of these day-rooms.

HADDINGTON, County Gaol

That part of the prison, which is allotted to criminals and vagrants, consists of four cells on the ground floor, measuring respectively, thirteen feet by eight, and one on the second-story, measuring eleven feet by seven.—It is difficult to conceive any thing more entirely miserable than these cells ; very dark, excessively dirty, clay floors, no fire places, straw in one corner for a bed, with perhaps a single rug, a table in each of them, the receptacle of all filth.—Its miserable inmates never leave their cells, for there is no change of rooms, and no airing ground. There were at different times, 3160 debtors, be they healthy or sick, confined day and night, without change or intermission whatsoever, in a closet, containing one small bed, and measuring not quite nine feet square.

ABERDEEN County Gaol.

The prisoners pass their whole time in cells, there being no airing ground in the prison, and no separate accommodations for sleeping. We were first introduced into a small room,

brought before the public, by these concurring testimonies, will naturally be astonished, that in a country like England, such abuses should be allowed to prevail; and will, perhaps, be led to afford his co-operation to these distinguished individuals, who seek to wipe off this foul stain on the justice and humanity of the country.—If it were the author's intention, to heighten the colour of the picture drawn by others, he could, from a very minute and general inspection of the prisons of these countries, made with a view to ascertain their ventilation, state a great variety of particular facts, illustrative of the pernicious consequences, resulting from the *total* disregard of this most important measure.

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about fifteen feet long by eight in breadth, set a part for female criminals. There were four women in it, a man and a child. The room was most offensively close and very dirty, there were two beds in it,—in one lay the man, in the other an elderly woman, both ill; the child also looked very sickly. *We thought we perceived symptoms in these invalids, of gaol fever;* and indeed, it was scarcely possible, that so many persons, should continue, night and day together, in so very close an apartment, without the production of fever and infection.

The debtors are crowded together, and crowded together they continue day and night without change.

GLASGOW GAOL.

On the other side of each gallery, are ranged seven sleeping cells, measuring respectively, six feet three inches by ten feet four. These sleeping cells are very dark, and extremely ill ventilated, for they receive neither light nor air, except from the gallery, and that only through a hole, twelve inches in diameter, cut in the stone above the door. When the doors of some of them, which contained prisoners locked up during the day, by way of punishment, were thrown open to us, the sickly stench was so excessively offensive, that entrance into the cells, was nearly impossible.

Only one flat is allowed to female criminals of every description. We found in it, sixteen women, who appeared much

The spirit of prison reformation, has not made the same progress in Ireland, as it has done in this country, and the state of its prisons has not unfortunately been made a subject of parliamentary inquiry. The published documents respecting them, are necessarily very scanty. Howard * has afforded some information, and the author's own observations enable him to state, that their ventilation is in general extremely imperfect, in some instances it is altogether neglected, and that the usual ill consequences follow from this neglect. The information so obligingly communicated to me, by my friend Doctor HARTY, who has many years filled the situation of physician to the prisons of Dublin, is well calculated under every point of view, to engage the attention of those who have

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much crowded, for want of more space; yet within the same limits, are not unusually confined, as many as thirty females. —Where this is the case, they sleep four together, and *from the excessive want of ventilation in the sleeping cells, must experience sufferings, nearly allied to suffocation.*"—*Notes on prisons by Mr. Gurney.*

* Mr. Howard says, "I well remember the dreadful state of Dublin *Newgate*, in the beginning of the year 1775, when I saw numbers of poor creatures, ill with the *gaol fever*, unattended and disregarded.

I carefully inspected the gaols in Dublin, in 1783; the following remarks on the *new prison*, I think worth mentioning:— It is not kept clean.—The proper prisoners have not the use of day rooms.—The sick have not proper rooms or beds. Two of the committee of the House of Commons in 1782, accompanied me to the new prison, and examined some of the sick, who lay on the stone floors totally neglected. Dr. *Cleghorn* and Dr. *Scott*, had been since ordered by the grand jury, to attend them, but no bedding, no alteration of diet, no nurses were ordered to attend them. I was sorry to find in 1783, that the former ingenious young physician, had died of the *gaol fever*.....Most of the remarks now made, in this gaol at Dublin, are applicable to many of the *county* gaols."

it in their power to redress the evil which this experienced and accomplished physician, has so decidedly complained of.*

In

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* 32, Gloucester-street,
October 7th, 1819.

"Dear Sir,

"I was yesterday favoured with your letter of the 4th instand, and have much pleasure in giving you every information however limited, in my power, on the important subject of ventilation, to which you have of late so ardently devoted a large share of your attention.

"You wish to be informed whether 'I consider the ventilation of the Dublin jails imperfect, and if so, whether I have observed disease or ill health produced in consequence.' It is with regret I answer, that I do consider the ventilation of the Dublin jails very imperfect; so imperfect indeed, that their architect (if he deserved the name) must either have been ignorant of its advantages, or, if aware of them, must have thought the benefit of pure air too great a luxury for prisoners to enjoy.—I might easily exemplify this position in any one, or in all our jails: take Newgate, however, as an instance, though parts of the Sheriff's Prison, far exceed that gaol in the appropriateness of structure for supplying air of the most impure character.

"The cells of Newgate communicate with corridores, which have, at *the female side*, windows opening to the interior of the prison, but which, *at the male side*, are now without windows, in consequence of a late alteration, made for sake of greater security. The *female* corridores are, of course, freely ventilated—indeed too freely; whereas the *male* corridores are badly ventilated, and still worse lighted. The cells (generally about nine feet high, and about twelve feet long, by eight wide) are calculated to accommodate three prisoners at the utmost; the doors are of grated iron, so that there is free admission for the air; but the emission of foul air is through a very small chink in the wall. During the summer months there is not sufficient space for the exit of foul air; and during the winter months, the doors are covered by mats, the prisoners themselves generally closing the chink with straw, to exclude the cold, so that there is scarcely any ventilation at all. In what state, then, must the air of these cells be, when five, six or seven persons are crammed into each cell,

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In offering the foregoing view of the *actual* condition of our prisons, derived from various authorities, whose accuracy and means of information on

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as has been, and is still too frequently the case, and consequences, such as might be expected, have resulted. Fever has seldom been absent from the prison for any length of time during my attendance, a period of nine years; and except during the late epidemic season, (when contagion was generally introduced from the city) was almost always to be traced to the crowded cells. Should your system of ventilation (which possesses such obvious advantages) be applied to remedy this defective structure of the cells of Newgate, it would, I conceive, materially diminish, not only the prevalence of fever in that jail; but the general predispositions to disease amongst its inmates.

"Believe me, dear Sir,

"Very truly, your's,

"WILLIAM HARTY,

"Physician to the Prisons of Dublin, &c. &c.

"A. MEYLER, Esq. M. D."

32, GLOUCESTER-STREET,
January, 31*st* 1822.

"DEAR SIR,

"Anxious to promote your object, the introduction of an efficient plan of ventilation into our public buildings, I lose no time in replying to the enquiries in your note of yesterday's date, and beg to state, that every days experience convinces me more and more, of the truth of the remarks contained in my letter of October 1819, to which I would further add, that our new prison, the Richmond bridewell, would be materially benefited by the introduction of your system of *warm air* ventilation.—The work rooms of that prison, are large, and in winter, excessively cold, owing to the very defective structure of their fire places, and to the size of the apartments. The female prisoners employed in the spinning of worsted yarn, a more inactive occupation than that of linen yarn, suffer much from cold, in the production of rheumatic and catarrhal affections.—Were the apartments heated by warm air, according to your

on cannot justly be questioned, it may be of importance to endeavour to dissipate some errors which prevail respecting the health of our gaols, and which may have contributed with many to prevent their reformation. The internal situation and œconomy of these establishments are necessarily concealed from general observation, and those under whose jurisdiction they are placed, do not usually visit them till after they have been cleaned and ventilated, they are not consequently aware of the state of the atmosphere which the prisoners *usually* respire: nor can they be fully sensible of all the ill effects produced by the respiration of impure air. The squalid and unhealthy appearance of the prisoners is attributed to other causes, or perhaps, it is altogether overlooked or disregarded. Many also suppose, that there is no disorder in a gaol, unless a highly malignant fever should happen to prevail in it, and as if there were no necessity for humanity to interfere, unless in cases of general and alarming mortality.

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your plan, these effects, would, in my opinion, be obviated, and a great ultimate saving effected. The male prisoners, who are more actively employed, enjoy good health, but they are of a younger and more healthy description on admission, than the females. Any further information on these subjects, in my power to give, you may freely command, as I have no doubt, the prisoners would be greatly benefitted, and my labours greatly lessened, by the application of your system of ventilation, to the prisons of Dublin.

"Yours, dear Sir,

"Very faithfully,

"WILLIAM HARTY."

"A. MEYLER, Esq. M.D."

&c. &c.

That

That most malignant disease described by our medical writers, and known by the appellation of the *gaol fever*, is sufficiently well proved to originate in these places from neglect of cleanliness and ventilation, and though it does not now assume that pestilential character which formerly distinguished it, it is still in existence, though in a more mitigated form. It is unfortuately also a very general mistake to suppose, that there is no febrile contagion in a gaol, unless this disease is prevalent among the prisoners, or that a person cannot communicate a disease with which he may not at the time be himself infected.

But this is so far from being the case, that the danger of contagion from a person labouring under the gaol distemper, or common typhus, when kept perfectly clean, is found to be much less, than from the contaminated clothes and rags often carried about by a healthy prisoner, but which are imbued with the infection emitted or generated in the prison. The instances already recorded, sufficiently prove, that even in an open court of justice, the infection from the clothes of prisoners, manifested a very destructive malignity, and the same disasters, though in a less degree, are of much more frequent occurrence than people usually imagine. Doctor Adams, in his work on epidemic diseases, says there is rarely a gaol delivery, without the introduction of typhus into the Work-house.——The acquitted prisoners shelter themselves in some confined and wretched habitation, from whence, on account of illness, the parish find it necessary to remove them, or those whom they have infected, into the Work-house. These disasters are doubtless, to a considerable degree now lessened, and by means of fever hospitals, the diffusion of disease is arrested, but the source of them should be removed as a cause of danger

danger to all. The progress or the history of a prisoner after his discharge is necessarily known to few, and his subsequent death or sickness may be productive of no sympathy. But let us follow him from his prison, from whence he has been released, to his new and equally wretched residence, with a contagious atmosphere hovering around him, and the seeds of disease sown with a plentiful hand on his infectious clothes, and perhaps also, with the miserable materials which formed his infectious bed. The immediate inhabitants of the place imbibe the contagion and sickness; the disease will not cease with the individual who introduced it, nor will it be confined to those in his immediate vicinity: under circumstances favourable to its diffusion, it has, and it may again acquire a wider and more destructive sphere of activity.

One of the sources of infection most prevalent in our fleets and armies are the gaols, and our medical writers, constantly trace the importers of infection to these crowded and ill ventilated habitations.*

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* "Gaols have *often* been the cause of malignant fevers. In the late rebellion in Scotland, above two hundred men of one regiment, were infected by the gaol fever, brought by some deserters, from prisons in England."—*Observations on the diseases of the army, by Sir John Pringle.*

"The source of infection in our fleets and armies, are undoubtedly gaols; we can *often* trace the importers of it, directly from them.....It often proves fatal in impressing men, on the hasty equipment of a fleet.....The first English sent last war to America, lost by it, above 2000 men..... The seeds of infection, were carried from the guard ships into our squadrons, *and the mortality thence occasioned, was greater, than by all other diseases, or means of death put together.*"—*Dr. Lind's essay on the health of seamen.*

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The imperfect ventilation of prisons, renders them also peculiarly liable to multiply infection, when it is once introduced into them. The same degree of contagion, that in an open and well aired apartment, would be incapable of being communicated to others, when brought within the confined and gloomy walls of a prison, will

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"The disease which prevailed among the troops of the Earl of Moira's army, was fever, of a decidedly contagious character. There is reason to believe, that it was introduced into most of the corps, by recruits from the independant companies, many of whom were drawn from *gaols* and manufacturing towns, where the seeds of fever generally exist.—*Jackson on contagious fever*, 1819, *p.* 7.

"In January 1790, the Gorgon arrived at Portsmouth, with a number of troops on board, from Chatham. While she lay in the harbour, a fever prevailed among the soldiers, and *several died.* On visiting the ship, I found 16 men, ill of typhus fever, and one or two with symptoms of immediate dissolution. Upon careful investigation, and inquiries put to the convalescents, that were walking about, I found that the fever had been brought into the barracks at Chatham, where they were embodied, by two deserters from the guards, *who came from the Savoy prison*, and entered into the corps on condition of pardon."—*Trotter's medica nautica.*

Here, in all probability, as much loss occurred from the sickness and death of the men infected from this prison, as would have built a commodious and healthy one, and yet were an effectual method for its ventilation suggested, it would be, perhaps, opposed on the grounds of expense.

It were easy to multiply instances of this mischief from gaols, but those which have been mentioned, are it is presumed, sufficient to shew, that even, if no mercy were due to prisoners, the preservation of their health is a national concern of no minor importance. Our prisons have contributed their full share towards recruiting the army, enlisting being the condition on which many have obtained their release from confinement and immunity from some other punishment. Surely, therefore, arrangements should be made, that they may not carry, as they frequently have done, a fatal and contagious disease along with them.

exert its baneful influence with increased and increasing malignity, notwithstanding every effort that can be made to arrest its diffusion.—When fever thus introduced, has pervaded the entire of the prison, and the separation and removal of the sick, along with other active measures of security, have ultimately succeeded in destroying it. it is supposed that all danger from the infection has ceased on the subsiding of the disease, and the cause of its original diffusion is permitted to remain. In this manner, prisons *continue* to be frequently overrun with fever, from our neglecting to apply the proper measures of security. Unfortunately, the real cause of the evil is not seen. When fever appears, it is regarded as an unavoidable or natural occurrence, and when disease is not present, it is not considered necessary to take any measures for its future prevention. Such is the history of many prisons as detailed to me by their medical attendants.

There are few prisons where typhus fever has not occasionally prevailed to an alarming extent, and in many of them, though mild in its appearance, and circumscribed in its action, it is almost always in existence.

We should therefore, even for our own security, guard against the accumulation of these morbific effluvia, lest some peculiar state of the atmosphere, or some other exciting causes, may call them into general and fatal activity. For it is a fact, sufficiently well established, though we are ignorant of these agencies, that give to contagion all its virulence; that the same source of disease, which at one time lies inert, will, at other times, acquire a most extensive and alarming diffusion. It is therefore a dangerous error, to calculate on security, because the maladies of our prisons, appear to be mitigated and cir-

circumscribed; until these wretched abodes of misery are kept in a better state of ventilation, fever will continue to be generated, its contagious virus will be accumulated and concentrated on their walls, where it will remain a fertile source of danger to the nation. Work houses and prisons are the great nests of contagion, and it is from these prolific and impure nurseries, that disease is introduced into our naval and military establishments; their state, their ventilation, and every regulation calculated to preserve their internal health, becomes not only an individual, but a national concern. Let it not be supposed, that the disasters resulting from neglect of ventilation, are the disasters of former periods. Though much has been accomplished in their prevention, much also remains to be performed, and humanity has yet a wide field for new triumph.

Even in the prisons of the metropolis, from a recent parliamentary investigation, we learn, that in the nineteenth century, owing to want of ventilation in one of our chief prisons, (Newgate) that 442 cases of fever occurred within the short period of eight months, that out of 2400 prisoners, 511 were diseased; that the bed rooms are ill ventilated, cold and damp, and that the prisoners are obliged, as a measure of security, to sleep in the rooms which they have occupied during the day; that the cells are damp and unwholesome, and that their construction, as well as that of the day rooms, obstructs the free circulation of air.

These are statements authenticated by the most competent authority, and made before the highest tribunal of the country; and surely, they call in every point of view for investigation and redress. If the security of society authorises us

to immerse the criminal within the strong hold of a prison, every sentiment of humanity and justice, protests against any unnecessary infliction of punishment. In depriving a fellow creature of liberty, we have no right to confine him in an atmosphere which may deprive him of life. The benevolence even of the legislature admidst a variety of severe enactments, for the punishment and prevention of crime, provides for the health of the prisoner, for the same law which authorises the magistrate to secure the person of an offender, commands him also by positive enactments, to take competent measures for the ventilation of the prison*, and surely the humane dispensations of the legislature will not be these which are *alone* unattended to.

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* The 14th Geo. III. c. 59, enacts, "Whereas the malignant fever, commonly called the gaol distemper, is found to be owing to want of cleanliness and fresh air in several gaols, the fatal consequences whereof might be prevented, if the Justices of the peace were duly authorised to provide such accommodation in gaols as may be necessary to answer this salutary purpose; it is enacted, that the Justices *shall* order the walls of every room to be scraped and washed once every year, *and constantly supplied with hand ventilators or otherwise.*"——When this act passed, Dr. Hales's mechanical mode of ventilation was adopted in many prisons and hospitals. The apparatus placed by him on Newgate, cost the nation, it is said, several thousand pounds. Since that period, ventilation has been better understood, and the means of effecting it have been simplified.

The greatest improvement in the ventilation of prisons would be effected by the introduction of warm air, which would preserve their cells dry, carry off the animal effluvia, and promote the health of the prisoner, by affording him both warm and pure air.

The injury resulting from not supplying our prisons with artificial warmth is of a two-fold nature. The injurious effects of cold are increased by acting upon persons badly fed and clothed. To remedy the want of fire, they assemble in numbers in one room, to keep themselves warm by their breath,

and

We must also reflect, that the unfortunate and the innocent are not unfrequently the inmates of a prison. That the imperfection of our laws has peopled the same dark abodes with every class, and gradation of misery, as well as of crime, and all sexes and ages, the innocent as well as the guilty, the unfortunate as well as the wicked, the felon as well as the debtor, are all commixed and promiscuously blended together in one common mass of filth and wretchedness.—No reproach can be greater on the legislature of a country than that health has been least consulted in buildings devoted to the purposes of justice. The walls covered with damp, the chambers filled with foul air; even in the court yards, the walls are so high, that all due circulation of this fluid is prevented, and they should be considered rather in the light of wells, than as places where a pure atmosphere may be respired; the cells so dark as to exclude air and light, resembling more dismal vaults, unfit even for the abode of brutes, than places calculated for the residence of human beings; the smell so offensive, that we could not enter them, even for a moment, without disgust; and the clothes of the prisoners betraying the stench in which they are habitually immersed.

We cannot, therefore, be surprised, that under these circumstances the standard of the health of the prisoners is lowered by leaving them in a foul and stagnant air, impregnated with their own effluvia, and with all the oc-

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and for the same reason, they exclude the external pure and cold air, while they vitiate still more the air in which they are enveloped.

Mr. Villerme states, that in the prisons of the Prefecture of the police, for 1815-6-7-8, 1808 died, that is 452 annually.

occasional

casional and permanent effluvia of a prison. — It is not, therefore, surprising, that obstinate catarrhs, atrophy, anasarca, rheumatism, &c. should be induced in those who have even entered the prison in a state of health, while every other disease to which they may be accidentally subjected, will be rendered worse by the debilitating impression of the foul steams in which they live.

Amongst the many houses of confinement which I have visited, there is scarcely one, where in the meagre and sallow countenances of its wretched inmates, I did not witness the pernicious effects of this debilitating agent, and it is impossible for any humane individual to view the pale, dim face of a person who has been for any length of time within their walls, without giving his zealous co-operation to the means best calculated for their removal.

" You have *no right*, (says Mr. Buxton,) to abridge a prisoner of pure air, or to ruin his health by forcing him into a damp, unventilated cell, with such crowds of companions, as very speedily render the air foul and putrid, or to make him sleep in close contact with the victims of contagious and loathsome disease, or admidst the noxious effluvia of dirt and corruption,"

Amidst this disgusting detail of disease and mortality and wretchedness, it is consoling to reflect on the enlightened spirit of benevolence which has been the means of bringing these scenes to light, in order that they may be reformed, and which in the co-operation of active and influential individuals, has afforded bright prospects of future amendment.

Humanity has forced the iron gates of the prison, to domesticate the benign influence of moral instruction, in mansions which have hitherto served as much for the increase, as for the punish-

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ment of crime. Even the female in the zeal of an enlightened benevolence, has conquered the instinct, which repelled her from the vicious, and has descended like a benignant spirit into these dark and repulsive abodes of hopeless misery and vice, to refresh them with the pure spring of wholesome industry, and to pour over their intellectual darkness, the redeeming light of that divine revelation, which every good man must respect, and which every Christian will revere.

In the full and meridian splendour of this happy spirit, which has lighted up the nation, we cannot suppose, that apathy will alone prevail, where the power of redress is confided, and that those to whom the regulation of these respective establishments is entrusted, will not evince their visible sign of active humanity, in preventing the continuance of these disgusting scenes which are daily outraging every good feeling, endangering the health, and reflecting on the humanity of the nation.

Ventilation.

The injury resulting from defective ventilation, having been shewn from such various facts and authorities, our next object of inquiry is to ascertain, how far this most important measure is attained by the means now usually employed.—Heat which expands air, and alters its specific gravity, is the great agent under all circumstances in effecting ventilation. If we open the door of a room heated by fire or by crowds of people, and place a lighted candle at the bottom of the door. The flame of the candle will be blown inward, in consequence of the cold and heavy air rushing in from below. If a lighted candle be placed at the top

top of the door, the flame will be directed outwards in consequence of the current of the heated air, escaping from the upper part of the room.

The imperfection of ventilation produced in this manner in private houses, hospitals, &c. will be best evinced by reviewing the course which the air is now necessarily compelled to take, under the existing circumstances of their construction. The air which we expire in consequence of the heat which it has acquired in passing through our lungs, becomes rarefied, and ascends to the top of the cieling.—No outlet being afforded for its escape, it necessarily remains there till it becomes cooled, when it will descend. The descent is also accelerated by the ascent of another portion of air, rendered warm by respiration, This also, will in its turn, descend, and in the circuit which the air takes under these circumstances, the *same* fluid constantly passes through the lungs of different individuals, imbibing at each time, a fresh accession of impure effluvia, and loosing by each respiration a portion of its vital principle. Thus, while with a fastidious and justifiable refinement, we decline drinking from the glass which has been merely pressed by the lips of our friends, we feel no hesitation in breathing an atmosphere vitiated by the respiration of every promiscuous assembly.

The ventilation obtained by means of doors, consists in circulating the air vitiated in one apartment through the rooms immediately above it. The warm and impure air of the kitchen, for example, escapes from the top of the door; in its ascent, it becomes cooled, and arriving in the hall, it passes at the bottom of the door into the parlours. Having served for respiration there, it becomes rarefied, and on the door being opened, makes its escape; it then ascends to the drawing-rooms, where having acquired a new accession

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of impurities, it travels up to the bed-chambers, and having successively in this manner, passed through all the apartments of the house, and no means of escape being afforded, it becomes cooled in the stair-case, and again descends to run the circuit it did before. This impure air, to a certain extent, escapes by the chimnies of the different rooms into which it passes, and it is also blended with the fresh air proceeding from the external doors and from the windows, but such essentially is the course it takes, in consequence of the imperfect ventilation of our dwellings.

Without the necessity of reasoning on the imperfect circulation of air, produced in this manner, we will best judge of the fact, by the unerring testimony of our own sensations. If we come immediately from the open air into a crowded room, or a bed-chamber, or dining parlour, we will be at once convinced of the impurity of the air with which they are filled, and consequently of the imperfection of their ventilation.

Were we early in the morning to visit the rooms of a barrack, the hold or cabin of a ship, the wards of an hospital, or the cells of a prison, before the windows of these respective places have been opened, we should then best judge of the imperfection of the usual modes of ventilation and of the poisonous state of the atmosphere, which their inhabitants usually respire.

Fire contributes in a very eminent degree, to promote the circulation of air, causing it to pass off by means of the chimney, whilst there is a continual influx of cold air, from the doors and windows, to supply its place. The circulation of air, produced in this way, is not only inadequate to effect the full degree of ventilation required, more particularly in hospitals and all crowded places ;

but it subjects us also, to the unpleasant, and often injurious consequences, resulting from partial currents of cold air, and to the unequal and irregular warmth, produced by the action of the fire, on one side, and of the cold air rushing in from doors and windows on the other. It is also deserving of observation, that the cold air on its entrance into the room, *immediately* proceeds to the fire, from whence it is carried off, whilst the heated and impure air occupies the upper part of the room, where it remains to be *repeatedly* respired.

Besides the ventilation which depends on fire alone for its production, is necessarily in most apartments only occasionally excited, when in fact it should be always in action, and independant of the influence of any mechanical or adventitious agency.

The occasional opening of doors and windows in close and crowded rooms, to promote a circulation of air, admits partial streams of cold air on those previously overheated; this mode of ventilation is also, only occasionally in action, it is altogether suspended during the night; while respiration is incessantly vitiating the atmosphere. We must also consider that these inlets to pure air, are more confined during winter, and that to avoid its impression as much as possible, we use every expedient to exclude it altogether, and are thereby reduced to the necessity of respiring a still more contaminated atmosphere. Our sensations lead us to guard against partial impressions of cold air, and we prefer suffering the less apparent danger, to guard against the one which is most obvious, but perhaps on the whole, not so fatal.

If ventilation be defective, even with the combined agency of doors, windows and fires, how much more must it be deficient in bed-chambers, where, instead of seeking to promote ventilation,

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we use every practical expedient to exclude the external atmosphere. The door is surrounded with list and other precautions are employed to prevent as much as possible any access of pure air by means of that inlet. The windows are fortified by sand-bags, and are farther secured by a triple barrier of rollers, shutters and curtains. Least the chimney should exert any salutary influence, or be the means of introducing pure, or of discharging impure air, it is secured by a board, or perhaps it is closed altogether. And to render the work of mischief as complete as possible, we surround our beds with curtains, which we also carefully close, to prevent as much as we can all access of pure air. Fortunately for us we are not able altogether to exclude the atmosphere, it will still make its way through all the barriers we oppose to it. But though we cannot do all the mischief we seek to effect, we are still enabled to accomplish much.—Our feverish and disturbed sleep, our laboured respiration, the lassitude we experience in the morning from unrefreshing rest, and our impaired digestion, are the effects of our precautions to exclude the atmosphere.

If we allow only eight hours in the twenty-four to sleep, though many, more particularly females and invalids, spend a much longer time in their bed-chambers, we shall find, that during more than one third of our lives, we breathe a stagnant and and impure atmosphere, loaded with animal exhalations.

Children to whom the respiration of pure air is of still more vital importance, even than it is to adults, are every day the victims of our neglecting to procure for their close and frequently crowded nurseries, an adequate supply of pure air.—But habit blunts our perception of the evil, and we refer to other causes, many of diseases which

are solely produced by the respiration of an impure atmosphere.

The observations on the defective ventilation of private houses, apply also to HOSPITALS—the circulation of air produced in them, is defective, inconvenient, intermitting, suspended during the night, and the lower wards send their foul atmospheres into those immediately above them. The windows also admit cold currents on the patients, and blow back on them and on others, the putrid effluvia which have been emitted, thereby contributing to the diffusion of contagious diseases.—At best the ventilation effected by their means, contributes rather to mix the fresh with the impure air, than to produce that constant and effectual interchange, that would be effected by discharging the impure air with as much rapidity as it is vitiated, and in affording an uniform and unintermitting supply of a purer and more wholesome fluid. Even when windows are alone depended on to effect the ventilation of hospitals, the best construction and arrangement of them is not always employed to secure the most perfect interchange of the external and internal atmosphere.—The windows seldom reach to the top of the cieling, which it would be necessary for them to do, in order to prevent the lodgment and subsequent descent of the impure air, which has ascended to the top.

Were we not to consider the injury resulting from partial currents of cold air, and from its flowing down on the beds of the patients, we certainly would be enabled to ventilate, most effectually, an hospital, by means of windows alone, so far as producing currents of air, may be considered ventilation. But even to do this, several favourable circumstances must concur to render ventilation, even in this manner, effective. The

hospital

hospital should be built on an open and elevated situation ; the wards should be single ones, so as to have windows opening in every direction of the wind ; the windows should descend from the top to the bottom of the rooms, and they should be also always kept open. Where all these circumstances do not combine, the circulation of air, produced merely by doors and windows, independantly of its other inconveniencies, is also defective.—It is sometimes attempted in hospitals and other large buildings, where crowds of people are assembled to promote ventilation by inserting large tubes, opening from the top of the room into the atmosphere. But it is constantly found, that instead of the hot and impure air of the room escaping by these tubes, that they serve as inlets for the external atmosphere ; and those who are under them will sensibly perceive cold air flowing down from them.* Those who consider the doctrine of ventilation with reference to specific gravity, frequently only calculate on the ascent of warm air ; they do not reflect that these tubes equally serve for the descent of the cold and heavier air. The doctrine of hot air ascending, and cold air descending, should be considered with reference to these currents, which perpetually agitate the great body of the atmosphere. Under this point of view we may class the ventilation attempted to be effected in hospitals by opening lateral communications with the external air at the top and bottom of the walls, with the idea that the openings at the top will permit the internal air to

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* This has been a great source of annoyance in the House of Commons, as well to those in the gallery, as to the members. Some of the gentlemen who report the debates have been confined with colds in consequence.

escape,

escape, while cold and pure air will enter by the lower orifices. There are, however, several defects attending this mode of ventilation. In warm weather, when the heat of the internal atmosphere and that of the hospital approach nearly to each other, the interchange of air, produced by difference in specific gravity is inconsiderable. This mode of ventilation, therefore, becomes most languid, precisely at the period when it is most required to be active; and when from the external warmth it might be safely pushed to any desirable extent.—This provision for ventilation is also modified by atmospherical currents, which perpetually vary and suspend its action. These orifices are seldom open in more than two directions; and as the wards are always full of air, they will not exert any influence in promoting a circulation in this fluid, unless when the wind blows directly into them. In cold weather partial and dangerous currents are produced, and cold air will flow down on the beds of the sick from these upper orifices which are made for the escape of the impure air. Sometimes this contrivance is varied by opening orifices in the centre of the ceiling and of the floor, which communicate by means of tubes with the external atmosphere. The principle is the same with the other; the same objections apply to both, with the exception of the production of partial currents; but the interchange of air, effected by these tubes, is still more defective than that by the orifices placed in the walls, and in the summer, it literally amounts almost to nothing.

The ventilation of PRISONS is infinitely more defective than that of hospitals; there is less provision made for the circulation of air, and that which is adopted is almost in every respect objectionable.—The sleeping cells of prisoners frequently

quently open into an intervening corridore, and holes are opened at the top of the cells, with a view of sending their foul air into the corridore; but a little reflection will shew that this merely produces an interchange of the air of the opposite rooms. Sometimes these openings are made into the yards; but these yards may truly be considered as cells; their high walls obstruct all access of pure air; their very smell is offensive on entering them: we may, therefore, safely conclude, that they constitute a very imperfect source of pure air to those cells which open into them.—In addition to all these defects of prison ventilation it may be added, that every thing connected with them contributes to vitiate their atmosphere, and in their construction it would appear that their respective architects took as effectual care to *confine* the air as the prisoner.

In Churches and Schools we witness the same defective ventilation, the same accumulation of animal effluvia, sufficiently perceptible on entering them, the same langour, oppression, and disposition to faint, as in other close, crowded and ill-ventilated places. Placing therefore out of consideration, the injury which the health *must* sustain from breathing this impure air, it is impossible, that either the business of education, or devotion, can go properly forwards under its oppressive influence. The steams from the number of people, becomes condensed on the windows, walls and furniture of these respective places, and produce permanent dampness, hence the chilly sensation experienced on entering them, and there is no provision made for the *proper* introduction of pure air. The danger of cold currents, renders it inexpedient to open the windows, and the dread of colds and rheumatism, leads us rather to respire an air, contaminated by the breath and exhalations

exhalation of others, than subject ourselves to the impression of these partial draughts of air. In summer, the heat of a crowded church is intolerable ; in winter, the church is cold and damp, and in both cases, it is injurious to health. Similar defects exist in theatres, courts of law and in all places of public resort. Even the palace of the monarch, where it would naturally be supposed, that every arrangement productive of health and comfort would be obtained, is not free from this general defect ; and the public prints continually inform us of ladies fainting from the heat of the crowded, and not adequately ventilated drawing room.

It is unnecessary to pursue this subject to a greater extent. All public and private buildings, may be said to suffer from defective ventilation. In all, when crowded, there is an accumulation of animal effluvia, and the removal of this great evil, can only be obtained by the introduction of partial streams of air ; the ventilation is therefore only occasional, it is also inconvenient, sometimes dangerous and always defective.

So difficult has it been found to establish a regular system of ventilation, by what may be called *natural* means, that there have been at times, employed by Dr. Hales and others, various mechanical contrivances to pump the air out of places, or to force air into them. Many of these are certainly very adequate to produce these effects ; but experience has fully proved, that any mode of ventilation requiring manual labour, or a moving power to effect it, will not be sufficiently persevered in. Fortunately, also, it is not necessary ; the properties of the atmosphere are sufficient of themselves, *under proper regulations* to produce an adequate degree of ventilation, without the aid of other co-operation.

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In adverting to the different modes employed to promote a circulation of air, it is hardly necessary to allude to these circular fly plates, which are placed in windows, and which are improperly termed ventilators. When the wind blows directly on them, they are put in motion, and in this manner, they serve to break and divide the currents of air that flow through them into the room ; but they are a very awkard and noisy contrivance, even for this object, and they certainly can have no possible influence in promoting ventilation. They are not self acting machines, giving motion or impulse to the atmosphere, but merely passive agents, indicating the action of this fluid on them.

It is not the object of this essay, to enter into a practical detail of the means of effecting ventilation, but merely to state the objects to be had in view in the attainment of this important measure. The practical means must necessarily vary with every variety of circumstance, but the principle which should guide our operations, is the same in all.—The great object in ventilaon, is to obtain in the first instance, a sufficient supply of pure air, the heated and contaminated air will *then* escape, if we afford it an opening. The fluid which is to force off the impure air, should proceed from without, and not from the internal parts of the house, where it is already vitiated. The egress, also, of the impure air, from each apartment, should be into the general atmosphere so as not to infect the other rooms of the house. The openings also, for the admission and egress of air, should be so regulated, as to be always in action, so that this fluid may be discharged with as much rapidity as it is vitiated. If, in addition to this, we make provision by means of valves, for increasing or diminishing the rapidity of its cir-

 culation,

culation, and regulate its admission, so as to avoid the usual inconveniencies of its introduction, preventing all partial currents, and causing an imperceptible interchange of the external and internal atmospheres, we will then accomplish every object to be wished for, in ventilation by *cold air.*

There is also another point of view under which the introduction of cold air into houses, should be considered. The rapid introduction of air obtained by opening doors and windows, too suddenly reduces the temperature of the room; and from the improper manner in which it is brought in, it tends more to mix the fresh with the impure air, than to produce that imperceptible interchange, which a well regulated system of ventilation would effect, and this also without introducing one half the quantity of air, rendered necessary by the usual modes. By a good system of ventilation the proper temperature of the room would be more uniformly preserved, and the danger arising from partial currents and sudden vicissitudes, would be prevented.

Since the improvements which have removed these local causes, that formerly vitiated the atmosphere of large towns, the relative mortality of the different seasons, has been altered. When the influence of high atmospheric temperature combined with moisture, increased the amount of the exhalations from the earth, Summer and Autumn, were formerly the most unhealthy periods. Celsus, who probably borrowed the idea from Hippocrates, has characterized the seasons in these terms. "*Igitur salluberrimum ver est, proxime deinde ab hoc hiems, periculosior æstas, autumnus longe periculocissimus.*"

This relative mortality has now been reversed. The causes of the morbific exhalations from the earth having been removed, the Summer and

Autumnal

Autumnal months have become our most healthy seasons, and the mortality is now greater in the winter. This mortality seems to be owing to the vicitudes of our climate producing colds, and consumptions. the great source of premature death in modern times. It is not however, to the influence of cold alone, that we are to attribute the mortality, it is to the *partial* impression of this agent, and to our exposure to sudden vicissitudes of temperature. The defective ventilation of our houses, causes them to be overheated, more particularly, when they are crowded; and it is not surprising, that so many females fall victims to consumption; when we consider the impression of the cold air on their delicate frames after leaving the heated atmosphere of a crowded assembly. We may, therefore, refer colds and consumptions chiefly to partial impressions of cold air, or to sudden vicissitudes of temperature.—In seeking, however, to obtain a more perfect ventilation of our private dwellings, as well as of our hospitals and other public institutions, it becomes necessary to consider the introduction of large quantities of fresh air with reference to our sensations.—In Summer, cold air ventilation, under most circumstances, may be pushed to any required extent; but during the greater part of the year, the free admission of *cold air* would be, in many instances, productive of greater evils, than those which it is calculated to remove. In Winter, therefore it becomes necessary to *warm* the air before we introduce it. The great objection to warm air ventilation hitherto has been, that the usual modes of supplying this fluid have been so defective, that only a small quantity of an overheated and burnt air has been obtained. This is not however, an objection to the admission of warm air, it only applies to the defective means by which this salutary measure

has been sought to be accomplished. If by a well constructed Hypocost, or warm air stove, we could succeed in producing an *abundant and unintermitting* stream of air heated from 60 to 80 degrees, the salutary influence of such an operation would be obvious. It would afford us in any desired quantity, and at any required temperature, a pure atmosphere, alike conducive to health, and to the comfort of those who are enveloped in, and who respire it.—The convalescence of the sick in hospitals would be eminently accelerated, and the generation and diffusion of disease would be in many respects prevented.*

There is another point of view under which this mode of ventilation may be considered. Churches, courts of law, and other large buildings, cannot be heated by any other means so regularly and so uniformly as by warm air. The influence of radiant heat, from open fires, is extremely limited; and in addition to this, it must be considered, that the greater part of the heat generated from fuel in our grates escapes by the chimney, and is literally to a great degree useless, in effecting the object for which it is intended; besides it subjects us to the inconvenience re-

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* "It is scarcely necessary to say, how much warm air avails in exciting and nourishing the vital powers. The healthy and robust, who need not such aid, feel renewed alacrity, as well of mind as of body, from it; to the weak and imbecile, and those exhausted by adverse health, it restores their enfeebled strength, and renovates, as it were, the deficient powers of life; it recruits and preserves muscular power; sharpens the declining senses; arouses the languid and almost stagnant circulation of the blood; quickens the pulse, (in old persons slow) and promotes a due distribution of fluids through the whole body, therefore restores the secretions and excretions already diminished, and nearly suppressed, especially perspiration."—*Gregory's Conspectus.*

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sulting from the unequal dispersion of heat and partial currents of cold air. By applying *all* the the heat of a fire in the first instance, to warm air, and then to transmit this warm air into the apartment, we diffuse through it an equal and uniform temperature.

Our sensations of heat and cold are chiefly influenced by the temperature of the medium which surrounds us, and there are no means by which heat can be so equally diffused as by a warm atmosphere.—The increased attraction of warm air for water,* renders it peculiarly serviceable

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* From Mr. Dalton's experiments it appears, that air of the temperature of 32°, is capable of sustaining only 1-200 of its weight of water in an insensible form. Its capacity is doubled by raising its temperature 20° it is again doubled by an elevation of 22°, again by 24°, again by 26°, and again doubled by an elevation of 28°; and so on in succession.—Thus, at 25° the air will contain 1-600 of its weight of water, at 47°, it will contain 1-50, and at 98° 1-25. It is rather a curious fact, that these increments of temperature, 20°, 22°, 24°, 26°, 28°, are in an arithmetrical progression, whilst the corresponding increment of the solvent power of the air is in geometrical progression. Humid transparent air, on its temperature, being reduced from 74° to 52°, will deposit 1-100 of its weight of water, and 1-200 more if cooled down to 32°, and at all common temperatures: the depression of a single degree will occasion a deposition of a little more than 1-30 of the whole moisture contained in the air. The application of these facts to the dampness produced in houses, and to its removal by warm air, is too obvious not to be applicable under many circumstances. Sugar houses, drying places, &c. are usually heated either by cockles or steam pipes: but from defective ventilation, the air which has been saturated with moisture, remains in the room; were warm air supplyed, the evaporation of the moisture would be infinitely more rapid. Hot air might also be usefully applied to the purposes of husbandry, to dry corn and hay, and thereby prevent these losses which occur from wet weather, during the time of harvest.

Heated

viceable in innumerable instances, as it absorbs and carries off the moisture which could not, by any other means, be so effectually removed.

There are few bedchambers that might not be advantageously ventilated by warm air, nor could any agency contribute more to the health of these apartments than sending into them a large stream of this fluid, that would dry up and carry off the exhalations of the night, preserving the bed-cloths

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Heated air might be applied with great advantage to dry corn; it would never be raised to a temperature sufficient to injure the grain; the state of dryness in which the current comes off, will shew when the operation is finished; but should the heat be continued ever so long, no loss can occur but that of time and fuel; the labour of turning the corn would be unnecessary, as the current of air, which will pass through it will dry it evenly, and the expence of a kiln-man would be saved. Corn dryed by this means would be in the state of the best foreign grain, which will produce flour (without artificial heat) able to keep for months, an object at present only obtained in this country, by care and experience, in the management of the present kilns, and too often attended with deterioration in the colour of the flour by over heat.

Many think our present kilns cause a sufficient portion of air to pass through the corn; but it is quite different from such a current as can be made rapidly to pass, and bring its portion of moisture along with it, which, in the present kilns, does not go off till a very high temperature is obtained.

The advantages of drying garden seeds, with heated air, so as to preserve them without injury has long been known, but as only of late years the application of heated air has been adopted on a great scale. I do not believe that any person has considered the use it may be of in effectually and rapidly drying grain to a large extent, although the saving of fuel in manufactories, hospitals and houses, is now fully proved; and yet there are advantages in the application to drying grain, which still makes the object of greater importance, and had speculators attended as much to science as manufacturers have been obliged to do, I am satisfied they would have been the first impressed with the magnitude of the object;

cloths dry and sweet, free from moisture and animal effluvia.

In libraries and museums, in offices, in the cells of a prison and in all places where warmth and dryness are required, and where fires are either inefficient or inadmissible, warm air ventilation is by far the most desirable and effectual agent in accomplishing these objects.

Few complaints have been more frequently reiterated than the comfortless state of large houses; the rooms unequally heated, cold and damp in winter; partial currents of cold air rushing towards the fire, and every other circumstance conspiring to prevent proper ventilation and to injure health. Modern

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object; and the many injuries which corn in store is liable to, would be long since prevented.

One thing is earnestly recommend, that if trials are made on kilns with heated air, they will not be taken up by those unacquainted with its mode of application. Many experiments have been made, and many failed before the true mode of its application was obtained, and even at present many are puzzled, who have fully succeeded in some cases, and were baffled in others apparently similarly circumstanced.

Hot air ventilation would be a cheap method of preserving the temperature of green-houses—it would carry off the perspiration of the plants, and efford them a contiuual supply of a pure atmosphere, which would add to their vigour and luxuriance; at present, the temperature of hot-houses. cannot be effectually preserved except by confining the air, yet plants require a regular renewal of this fluid, as well as animals.

Mr. Strutt, of Derby, to whom ventilation is so much indebted, keeps the due temperature in his mills, by warm air. In Manchester the temperature is preserved by steam pipes; and to do this effectually, ventilation is prevented, and the hot and impure air is preserved. The wretched children, and others, confined in these mills, exhibit in their pallid aspects the effects of the impure air which they breathe.—It is to be hoped that Sir Robert Peel, in his very laudable efforts to reform some of

Modern luxury seems to consist in excluding the atmosphere ; but this surely proceeds, not from any objection to pure air, but to avoid the unpleasant and dangerous influence of cold currents. Were the halls and stair-cases of a house adequately and properly supplied with warm air, there would then be no necessity for the construction of double doors, and they might also be left open with safety, and without inconvenience. The chief objection to hot air ventilation, has been its scanty supply, and in addition to this, it is sometimes impregnated with effluvia, which have escaped from the stove. Were the hall well supplied with a *full* stream of warm, and *not overheated air*, its beneficial influence would be perceptible in every part of the house. We would have full ventilation without any concomitant inconvenience, our rooms, when crowded, need not be overheated from an apprehension to introduce cold air, and every apartment might be fur-

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of the abuses of these places, will, as well as abridging the hours of the children's confinement in these mills, take measures for compelling their proprietors to give them pure air.

Warm air ventilation would eminently contribute to the preservation of our houses and furniture, for nothing can be more injurious to either than the constant deposition of water from the moist atmosphere of this cold and uncertain climate. The metallic ornaments become tarnished and rust, and the curtains, carpets and paper are spoiled. The servant who would not regularly undergo the labour of opening every window, and lighting a fire in every room of the house left to his charge, will not object to the trouble of lighting a single stove, which, if properly constructed, would send a stream of hot air through every apartment, which would penetrate every part, carry off all the moisture that a damp atmosphere might have deposited, and this without producing dirt, or any other unpleasant effects.

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nished with the means of excluding or introducing any requisite quantity of pure air at any desired temperature.

The perspiration of crowded assemblies, as well as that which is so copiously emitted from the surface of the body at night, would be by this means carried away, and our bed chambers and other apartments would be preserved dry and of a proper temperature.

The Romans, whose domestic œconomy and comforts, were in many respects inferior to ours, evidently appear to have excelled us not alone in the luxury of their baths, but also in the provision which they made for screening themselves from the impression of heat and cold. Their walks were constructed with a scrupulous regard to sun and shade, and every attention was made to refresh their houses with cool and salubrious air, and this too, from the quarter where it was considered most pure. We have constant reference in their writings to their HYPOCOSTS, or stoves, which heated their baths, and transmitted warm air into their apartments. Pliny,* in his des-

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* " Adhæret dormitorium membrum, transitu interjacente, qui suspensus et tabulatus conceptum vaporem salubri temperamento huc illuc digerit et ministrat."

" Applicitum est cubiculo HYPOCAUSTUM perexiguum, quod angusta fenestra suppositum calorem, ut ratio exegit, aut effundit aut retinet."—*Plinii Epistolæ, Lb.* 11.

" Idem cubiculum hyeme tepidissimum quia plurimo sole perfunditur cohæret HYPOCAUSTUM et si dies nubilus, *immisso vapore* solis vicem supplet."—*Ibid, Lb.* 5.

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cription of his two favorite villas, expressly mentions such an arrangement.

A well regulated supply of a dry, pure and warm atmosphere, must therefore be considered as a measure, not alone of comfort and luxury, but as one also of health. It would be the means of removing danger from our social and domestic intercourse, and of preserving the salubrity of our dwellings, by discharging from them, the impure air, with as much rapidity as it is vitiated, and by supplying its place with an uninterrupted current of a pure and more wholesome fluid.

The comforts and pleasures of life, depend less on a succession of high wrought luxuries and enjoyments, than on the removal of small, but perpetual sources of minor inconveniencies; and perhaps the lesser courtesies of life, and the participation of the more trifling, but habitual gratifications, constitute the chief sum of human happiness. Health also, is not in general, either caused or preserved by the occasional operation of extraordinary and powerful agents, it is sustained by the incessant, but imperceptible influence, of what may appear to many as secondary causes. Yet, surely, no agents can be more powerful in contributing to the health, and consequently to the happiness of life, than the purity of the air which we respire, and the well regulated temperature of the medium in which we live.

From the foregoing rapid summary of the connection of air with life, and of the dependance of health on the purity of the air which we respire,

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it appears that nature has made the most ample provision in the capacity, structure and œconomy of the lungs, for the full impression of this fluid on the animal frame. We respire incessantly, and the organs by which this function is carried on, are admirably constructed to promote the chemical action, which the respired air exerts on the blood, and through its means on every organ and function of life.—A fluid therefore, with which we have such unceasing intercourse, which is the great aliment of life, "in which we live, breathe and have our being," must necessarily, according to the state in which it is respired, be either a powerful agent in the preservation of health, or in the generation of disease, in imparting vigour and life, or in conveying into our frames the seeds of premature decay, or of death.

In reviewing the various agents that contribute to impair the salubrity of the atmosphere, animal effluvia have been found to be the most active, and their virulence has kept pace with their confinement and accumulation. Infectious diseases appear to originate amongst large congregations of men, and from the earliest records, we find, it is in cities that pestilence has been most frequent and destructive. The books of Moses abound with instances of pestilence prevailing in cities. In the time of the Prophets also, it was considered, that pestilential diseases, are the effects of a crowded population. "Thus saith the Lord, as I live, they that are in the wastes shall fall, and him that is in the open field, will I give to the beasts, to be devoured, and they that be in the *Forts and Caves*, shall die of pestilence."*

* Ezekiel, Chapter xxxiii

Numerous as are the facts and authorities referred to in the preceding pages, to prove the great waste of human life, caused by the accumulation of animal effluvia proceeding from defective ventilation, it will readily be admitted by those whose means of observation have been most accurate and extensive, that not *one hundreth part* of the existing evil has been detailed. Sufficient however is brought forward, to shew that it prevails to a great and alarming extent.

The proofs and illustrations have been so connected with the text, as to correspond with the theorems they were selected to demonstrate. They are the statements of men of grave, steady and extensive observation, who witnessed the events which they have recorded, who have watched over those whose diseases they described, who felt that their own lives, as well as those of others were at issue ; and seeing thousands of our soldiers and seamen swept off from the face of the earth, by the operation of *artificial* causes which proper care would have removed, they felt anxious to record the truth, and thereby, as far as in them lay, to prevent the recurrence of similar calamities.

It is however painful to add, that notwithstanding the mass of evidence which has been accumulated, and although the state of the public health, has at different times brought the question before the legislature, no efficient or general means have as yet been employed to remove the evil. It becomes therefore the more necessary, to have the case brought fully before the public view, that we should be *forced* to consider this literally *vital* question, not merely with reference to its extent, as it appears to common observation, but also in the more enlarged scenes of misery and devastation, of which it is the hidden, but not the

the less certain cause. Removed as we appear to be from any participation in the more aggravated consequences of our neglect, we cannot calculate on a continuance of security.

In presenting this detailed view of the actual injury resulting from defective ventilation, it is gratifying to reflect on the many circumstances that *now* lead us to hope for the total and speedy removal of this great cause of human suffering. Having triumphed in the most obstinately contested war in which this nation was ever engaged, a period of general and profound peace, has left to the legislature, the undivided consideration of the claims of humanity. By a happy coincidence also, the views of the healthiest and best portion of the public mind, are directed to the amelioration of the moral and intellectual condition of our fellow creatures. In a country, therefore like England, where knowledge is becoming every day more tributary to the wants of life, where humanity is studied as a science, and benevolence is practiced as a duty, the best mode of serving the community, is to point out those channels in which this good spirit may be most beneficially employed.

When the defects of our public institutions, as well as the means of removing them, are fully brought before the public view, the same humanity which has erected edifices for the poor, the infirm and the diseased, will, by an active and provident superintendance, consummate its great work. It will infuse new health and life into the crowded and sickly wards of the hospital—it will animate the solitary cell of the prisoner, with the refreshing breezes of a pure atmosphere, and soften the rigid features of legislative punishment, by the salutary and mild dispensations of an enlightened

lightened benevolence. It is works like these, that reflect the truest and most permanent glory on a people; it is the means of doing this, that constitutes the most enviable privilege of wealth and power enabling their possessors to improve the condition, and to refine and to exalt the character of the nation by the lights which they hold on high, whilst they themselves receive, from a thousand quarters, the reflected participation of those blessings which they seek to diffuse. In speculating on scenes like these, we perceive also, the admirable *contrivance* of the arrangements of providence, which has rendered every department of nature subservient to the exercise of humanity, and which, embracing the whole family of man, in one great chain of mutual dependance and support, has connected by an indissoluble link, the enjoyment of social security, with the practice of social benevolence.

FINIS.

APPENDIX.

It is after some hesitation, that I have resolved to publish the following documents, in connection with my "Observations on Ventilation." I was apprehensive, that any appearance of personal objects, might interfere with the benefits, which it is hoped may result from calling public attention to this important, and much neglected means of preserving the general health. It was the same sentiment that induced me to suppress my own observations, as well as the information I personally acquired, in a very extensive survey of the prisons and hospitals of these countries, and that led me to substantiate my opinions *solely* by quotations, from the printed statements of others, least the amount of the evil, as represented by me, might, by some, be considered as exagerated. Feeling, however, that my own personal direction may facilitate the introduction into our public institutions, as well as into our private dwellings, of a more efficient system of ventilation, than they have hitherto attained, I have ventured to hope, that the intervals allowed me, in the discharge of my professional duties as a physician, would not be unprofitably employed in endeavouring to carry into effect, this most desirable measure.

Under these circumstances, I have determined to submit the following very flattering testimonies of the success of my plan of ventilation, under almost every variety of circumstance: more particularly, as those only are selected for publication, which proceed from official authorities, or relate to buildings open to public inspection.

At

At a Meeting of the Right Honorable and Honorable the Dublin Society, at their House, Kildare-street, on Thursday, December 10th, 1818.

The Right Hon. Lord FRANKFORT DE MONTMORENCY, V. P. In the Chair :—

RESOLVED UNANIMOUSLY,—That the thanks of this Society, are due, and are hereby given to our worthy Member, Doctor Meyler, for the valuable Lectures delivered by him, in the Society's Theatre, on the important subject of Ventilation; and also for the liberal manner, in which he made these Lectures open to the Public.

Liverpool Infirmary, Dec. 4, 1819.

It having been determined at a meeting of the Faculty of the Liverpool Infirmary, to introduce Dr. Anthony Meyler's plan of ventilation into one of the wards belonging to the Lunatic Asylum.

We have the satisfaction of stating, that the experiment has been made under the immediate inspection of Dr. Anthony Meyler, and has fully answered our expectation. The apartment is not only well ventilated, but sufficiently warm for the comfort of the patients.

The plan has been some time in action, so as to give us an opportunity of ascertaining its effects.

The unpleasant smell of the room, arising from a great number of patients, has been completely removed.

The impure air is now carried off with as much rapidity as it is vitiated; while its place is supplied with an adequate and uninterrupted current of fresh atmospheric air.

This plan of ventilation has another great advantage, being always in action, independent of doors, windows and changes of wind; and producing no partial currents, nor unequal distribution of heat.

Physicians.	*Surgeons.*
John M'Cartney, M. D.	J Brandreth.
Thomas Renwick, M. D.	Richard Forshaw,
J. P. Brandreth, M. D.	R. Bickersteth.

The

At a meeting of the parish officers, physicians, &c. of the Liverpool House of Industry, January 4, 1820, the following report on the system of ventilation introduced into that establishment, under the superintendance of Dr. Meyler, was unanimously agreed to :—

The parish officers, physicians, &c. of the Liverpool House of Industry, conceive that they will best promote the general adoption of a most valuable system of ventilation, and express the high sense they unanimously entertain of its utility and success, by a plain statement of its effects, and of the circumstances attending its introduction into the Liverpool House of Industry.

There are two extensive wings connected with the general building of this establishment, running parrallel to each other, and similar in size, construction, &c. each wing consists of two stories, and each story contains one large room, and a smaller one opening into it ; these rooms are used as dormitories for the children.

One of these wings has been ventilated on Dr. Meyler's system, while the other depends for its ventilation on the means usually employed for this purpose. The windows of both the wings were closed and the doors were locked during the night, and the same proportion of children slept in each, in order that the effects of the new mode of ventilation might be duly estimated from a comparison between them ; 112 children slept in one of the ventilated rooms, the length of which is 77 feet, and the width 17 feet.

The atmosphere of the rooms ventilated by Dr. Meyler, on being visited early in the morning, and while the children were in bed, was found perfectly sweet and cool ; so much so, as to excite the observation, that any private bed-chamber, where only one or two individuals slept, would have been more offensive. On visiting the other wing, that had not the benefit of Dr. Meyler's plan of ventilation, the heat and smell were so extremely unpleasant, that the room was entered with reluctance.

It is unnecessary for the Parish Officers, Physicians, &c. to observe, how materially the health of the children must be benefitted by being enabled to breathe, during the night, an atmosphere divested of the noxious effluvia with which it formerly used to be impregnated.

The method employed by Dr. Meyler to effect ventilation is extremely simple. It is independent of the action of fire and

of any mechanical agency, and is produced solely by such means as enable the varying relative specific gravities of different portions of the atmosphere to exert their full and uninterrupted effects. The ventilation is independent of doors and windows; it is always in action; it is not affected by any variations in the wind; and it increases in activity in proportion to the number of people in the room; it causes no partial currents or unequal dispersions of heat; but produces its effects by bringing into the apartment, in the least objectionable manner, an adequate and unintermitting supply of fresh air, and thereby expelling the impure air with as much rapidity as it is vitiated. In fact, the air, when expired, is forced off immediately without passing through the lungs of any other individual.

Dr. Meyler's system of ventilation has now been some weeks in action, and the result of every observation and inquiry, has fully authorised the parish officers, physicians, &c. to bear their strong and unqualified testimony to its merits, hoping that all public and private buildings may reap the benefit of this valuable discovery, so conducive to the public health, and so simple and effectual in its action.

R. Morris, M. D. John Kearsley,	Church-Wardens.
Anthony Black, John Aldersey,	Overseers.
James Carson, M. D. Thomas H. Banning, M. D.	Physicians.
J. Little,	House Surgeon,
William Hardman,	Governor.

At a meeting of the parish committee, on the 5th January, 1820.

In consideration of the very favourable report of the church wardens, as to the effect of Doctor Meyler's ventilating one of the children's dormitories at the house of industry :—

Resolved—That Dr. Meyler be presented with the unqualified thanks of this board, for the services he has thus gratuitously rendered this institution.

By Order of the Committee,
EDW. BLACKSTOCK, Vestry Clerk.

Liverpool

Liverpool Workhouse, Feb. 12, 1820.

Sir,—I enclose you an official report of the comparative statement of the health of our ventilated and unventilated new nurseries, from the 12th December, 1819, to the 5th of February, 1820 inclusive, which the church-wardens directed Mr. Little, our house surgeon, to draw up, from which you will perceive the incalculable benefits that are likely to arise from your mode of ventilation, particularly in a workhouse population like ours, of nearly 1700 individuals. From this report, which has been drawn up with great accuracy, it appears that the wing ventilated under your direction, has been totally free from fever during the obove period. This wing contains 202 children. The opposite wing, which has not been ventilated, has produced four cases of fever within that time, though it is inhabited by only 118 children.*

It gives me great pleasure to be enabled to add, that the experience of every day, still further convinces me of the great utility and efficacy of your admirable system of ventilation; and as I have succeeded in inducing the church-wardens to have the other wing also ventilated according to your plan, I trust I shall be equally successful in obtaining its introduction through every part of our extensive establishment.

Wishing you every success in the prosecution of this humane and important measure,

I have the honor to be, Sir, yours, very respectfully,

WILLIAM HARDMAN, Governor.

To Dr. Meyler.

Liverpool Dispensary, 19th April, 1820.

Sir,—I beg to inform you, that the Committee of the Liverpool Dispensary, having examined the building since your arrangements for its ventilation have been completed, empower me to present you with this acknowlegment of their ap-

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* Eighty cases of fever occurred in the Work-house within the above period; the ventilated apartments alone escaped the contagion

probation

probation as to the very perfect manner in which you have effected the same.

I am with respect, Sir, your obedient servant,

WILLIAM HOPE, President.

To Dr. Meyler.

Liverpool Dispensary, April 20, 1820.

Dear Sir.—I am directed by the Committee, to transmit to you, the enclosed resolution, expressive of their sense of your manner of ventilating the Dispensary ; and am commissioned also by the medical officers of the house, to convey their testimony of the very effectual mannor in which it has been accomplished. Without being at all inconvenienced by partial currents, we obtain through the house, a full supply of fresh air ; and we may be truly said to live in a new atmosphere, since the introduction of your system of ventilation.

I am, dear Sir, your obedient humble servant,

WILLIAM WRIGHT, House Surgeon.

To Dr. Meyler.

Stoneyhurst College, Sept. 23, 1820.

Doctor Meyler having been employed to ventilate Stoneyhurst College, and his plan of ventilation having been in operation for a sufficient time to enable us to judge of its effects, we feel great pleasure in bearing our testimony in favour of its merit, and in stating, that it has fully answered those favourable expectations which we were previously led to entertain of it.

Dr. M. having been furnished with testimonials from others which enter more fully into the details of the means employed by him to effect this important measure, it becomes the less necessary for us to advert to those particulars ; and perhaps every necessary purpose will be answered by stating, that without suffering any inconvenience from partial currents of air, we are now completely relieved from a considerable degree of offensive annoyance to which we were previously subjected.—In particular, we advert to the inconvenience resulting from the necessaries, the smell from which pervaded the house to a considerable extent, when the wind blew in a particular direction, Dr. M. has not only succeeded in preventing an offensive odour from finding its way into the houses,

but

but he has also removed, to a considerable degree, the unpleasant smell in the necessary itself. The air of the chapel also, which was at all times close and disagreeable, from the number of persons occupying it, is now, in consequence of Dr. M.'s plan of ventilation, perfectly sweet and pure ; and this without any inconvenience.

JOSEPH TRISTRAM,
President of Stoneyhurst College.

The new and useful Plan of Ventilation which has lately been introduced into Liverpool, by Dr. Meyler, has been brought fairly into action, under his own superintendance, in the large and commodious charity schools, calculated for the accommodation of 700 children, lately erected in Jordan-street. The Committee of Management have *authorised* us to state, that they consider the experiment, which is the first that has been made in this town, on a new building, to have completely succeeded. The rooms have a free circulation of air passing constantly through them, without any annoyance from partial currents which renders the air within, although they are filled with children, respirable, free, and wholesome ; and the committee recommended the plan to the inspection of all those who take an interest in the ventilation of public buildings.—*Liverpool Courier, 10th January*, 1821.

London Chapel-House, Sloan-street, March 1, 1821.

Doctor Meyler having ventilated the chapel near the Pavilion, Sloane-street, and my house adjoining it, with WARM AIR, I feel it due to this gentleman to bear my testimony in favour of the very excellent manner in which it has been accomplished. From the opening of the chapel in 1812, the complaint was prevalent of its being cold and damp, and a temporary stove, which I tried near to the altar, failed in removing these inconveniencies. Since it has been ventilated under Dr. M.'s direction, the dampness has been completely removed, and the great quantity of warm air continually flowing into the chapel, has diffused through it an equal and uniform heat. I am enabled at pleasure, to turn the warm air from the chapel flue into different parts of my house, and the whole plan is so well arranged, and the supply of this fluid is so regular and abundant, that it is as much within the control of the person who manages it, according to my opinion, as the dispersion of water would be in a series of pipes connected with a well supplied and elevated cistern. It may be of importance also to observe, that the

the warm air is not contaminated by sulphureous, or any other noxious impregnation: nor does it cause that unpleasant sensation, which, in other instances, is experienced in places heated by warm air.

L'ABBE' VOYAUX DE FRANOUS, Chaplain.

Covent-Garden Theatre, March 13, 1821.

DEAR SIR—I have much pleasure in being able to state, that the WARM-AIR Ventilating Apparatus, which you have put up in Covent-Garden Theatre, appears to act exceedingly well, and is, in my opinion, far preferable to any thing of the sort that has been before attempted. I am so satisfied with it, that I propose, during the vacation, to extend it throughout the Theatre.

I am, dear Sir, your's, respectfully.

To Dr. Meyler. H. HARRIS.

New Theatre-Royal, Haymarket, August 27, 1821.

DEAR SIR—It gives me much pleasure in being able to certify, that the mode adopted by you for ventilating the Haymarket Theatre, has completely succeeded.

I am, dear Sir, your's, most faithfully,

To Dr. Meyler. D. E. MORRIS.

At a meeting of the Importers of Tobacco, and others interested in the trade, held this day, at the office of James Brown and Son, Edward Sephton, Esq. in the Chair.

It was resolved—That the thanks of this meeting be conveyed to Dr. Meyler, for the efficient ventilation of the tobacco warehouse at this port, by which their property will be preserved*, and the object of obtaining a free circulation of air is fully accomplished.

By Order of this Meeting,

JOHN BROWN, Secretary.

Liverpool, October 29, 1821.

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* The tobacco warehouse was ventilated in consequence of an order from the Treasury. The merchants having stated, that they annually sustained great losses by their tobacco heating, from the closeness of the building. A great variety of merchandize is injured in confined and damp ware-rooms, which would be preserved were these places adequately ventilated.

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Dublin, Royal Barracks, 29th January, 1822.

My Dear Sir—The plan of ventilation adopted under your direction in the Royal Barracks, in 1818, has been in full action ever since, and it affords me much pleasure to state, from my own frequent observations as well as from the reports of the medical officers and others, that it has, in every respect, answered the end proposed.

I have the honour to be,
My dear Sir,
Your very faithful humble servant,

EDWARD STANLEY, Barrack-Master.

To Doctor Meyler,
&c. &c. &c.

FINIS.